Popular Science Monthly

225 West Thirty-ninth Street, New York City

Vol. 92
No. 4

April, 1918

$1.50
Annually

Fishing Airplanes from the Sky in Nets

An ingenious plan for catching enemy airplane pilots in nets of piano wire

By Carl Dientsbach

FOR many years the scientists of European and American weather bureaus have explored the atmosphere kites from which thermometers, barometers, recorders and wind-measurers are suspended. These instruments are like pens in the hands of the air; for the air writes down how hot and cold it is, how much it weighs, how fast it is moving, and how wet it is. The kites are flown from thin but very strong piano wire. Whole batteries of kites are sent aloft and kept there for days at a time.

These piano wires were considered so dangerous to aerial traffic before the war that in the weather news published by the German Government for the benefit of aviators, the approximate location of the kites, which naturally changes with the wind, was never omitted.

If a few piano wires can be so dangerous in peace, what might not happen if a more elaborate wire system were deliberately resorted to in time of war for the purpose of netting high-powered flying machines? That is the idea of an Englishman, Mr. F. J. Lane, who wishes us to place it before the readers of the POPULAR SCIENCE MONTHLY. The present writer proposed the same system before the war.

His aerial entanglement is to be supported in feeble winds preferably by captive balloons or by kites. It is obvious that the system would hardly succeed in broad daylight, but it would be unquestionably efficacious at night, provided the enemy could not see the uppermost of the kites or balloons which support the netting. The wires would be provided with barbs, and their effect would be disastrous if they should ever be caught in a revolving propeller.

To cover great spaces the meshing of the net would be very coarse, measuring perhaps fifteen feet to the side. Indeed, the coarser the mesh the more likely is the plan to succeed, for the more difficult will it be to detect the piano wire.

The great vertical space to be enclosed is undoubtedly the chief difficulty encountered, even though we may consider the lower altitudes amply barred by anti-aircraft guns. An airplane has an up and down movement of miles; a submarine of only two hundred or three hundred feet. The success of the net depends clearly on driving the enemy pilot by gunfire or fighting craft into seemingly open lanes so ingeniously laid out that he never suspects the fate which is likely to befall him and regards the avenue as a means of escape.

Those who are familiar with the history of the airplane will remember the experiments made by Sir Hiram Maxim with his enormous, daringly conceived flying machine. During the course of these experiments a wire stay broke. In doing so it sheared off the propeller blades as if they were cardboard. Had the machine been actually flying in the air, it is easy to imagine what would have happened. And so with the enemy airplane that plunges into the net that Mr. Lane proposes. Any enemy pilot would crash to a ghastly death.

Consider Joe's Non-Skid Shoes. They're Made of an Old Tire

FURNACE CANYON is on the edge of the desert, miles from civilization. When Joe Boucek and his three partners were bitten by the Gold Bug about twelve years ago, they began to look around for the most forbidding piece of country in which to prospect. This search ended in the selection of Furnace Canyon.

Why doan' you-all w'ar non-skid shoes like we uns? They're shore the best ever

Until a few weeks ago no automobile had been able to penetrate the wilds of this canyon. The road was little more than a burro trail. The boulders were many, the sand holes deep, and the grades heavy. Joe was present when the first car broke its way into the canyon. When he spied those black-tread non-skids he let out a yell. At last his "sole leather" problem was solved. The morning after securing a discarded tire Joe appeared with his shoes non-skidded. He asserts that he now has enough material to last him ten years. By that time perhaps another automobile will "get through."

Utah Kills Four Thousand Rabbits at a Time

IN southern Utah the jack rabbits are so numerous that they amount to a veritable pest. "Drives" are held two or three times each winter to capture them. The rabbits are driven into corrals and then killed with clubs. Three or four thousand rabbits are shown in the accompanying picture. Would that Utah would drive rabbits toward the office of the POPULAR SCIENCE MONTHLY on a meatless Tuesday! We'd be there!

In some western states steps are being taken to utilize these rabbits on a larger scale than ever. There seems to be no reason why the rabbit industry may not become a large one in the near future, in order to help solve the question of the high cost of living.

Apparently the question of catching them solves itself. The only thing that would have to be thought out and arranged for would be their packing and shipment to the various markets.

Judging by the number shown in the picture, the rabbits must have adopted the faith of the founder of Salt Lake City.

Bunny-rabbits, and bunny-rabbits, and bunny-rabbits! This is a picture of a "drive" in Utah. The rabbits are so numerous as to be a nuisance, so they are rounded up, as above, and clubbed

The "Goofa" Is Now a Modern Side-Wheel Ferryboat

OVER on the River Tigris in Mesopotamia (Eastern Arabia) English soldiers are having unusual experiences in adapting ancient utilities to modern uses. One of the first institutions to receive their attention has been the venerable "goofas," or ferryboats, which natives have used unchanged for thousands of years. The English soldiers put paddle wheels on the "goofas."

Rub-a-dub-dub, three men in a tub. Not exactly. This is an army transport used on the River Tigris

"Goofas" are perfectly round in shape and made of willow limbs and twigs, just like a large basket. The outsides are covered with skins.

Navigating a goofa in its unimproved form must be akin to floating around on a magnified butter chip. When ordinary paddles are used as motive power, the goofa has a disconcerting habit of going off in any direction but that desired. Since it has no keel, or other directing device, it is difficult to keep it on a given course. But with paddle-wheels the goofa crosses the river with unprecedented directness.

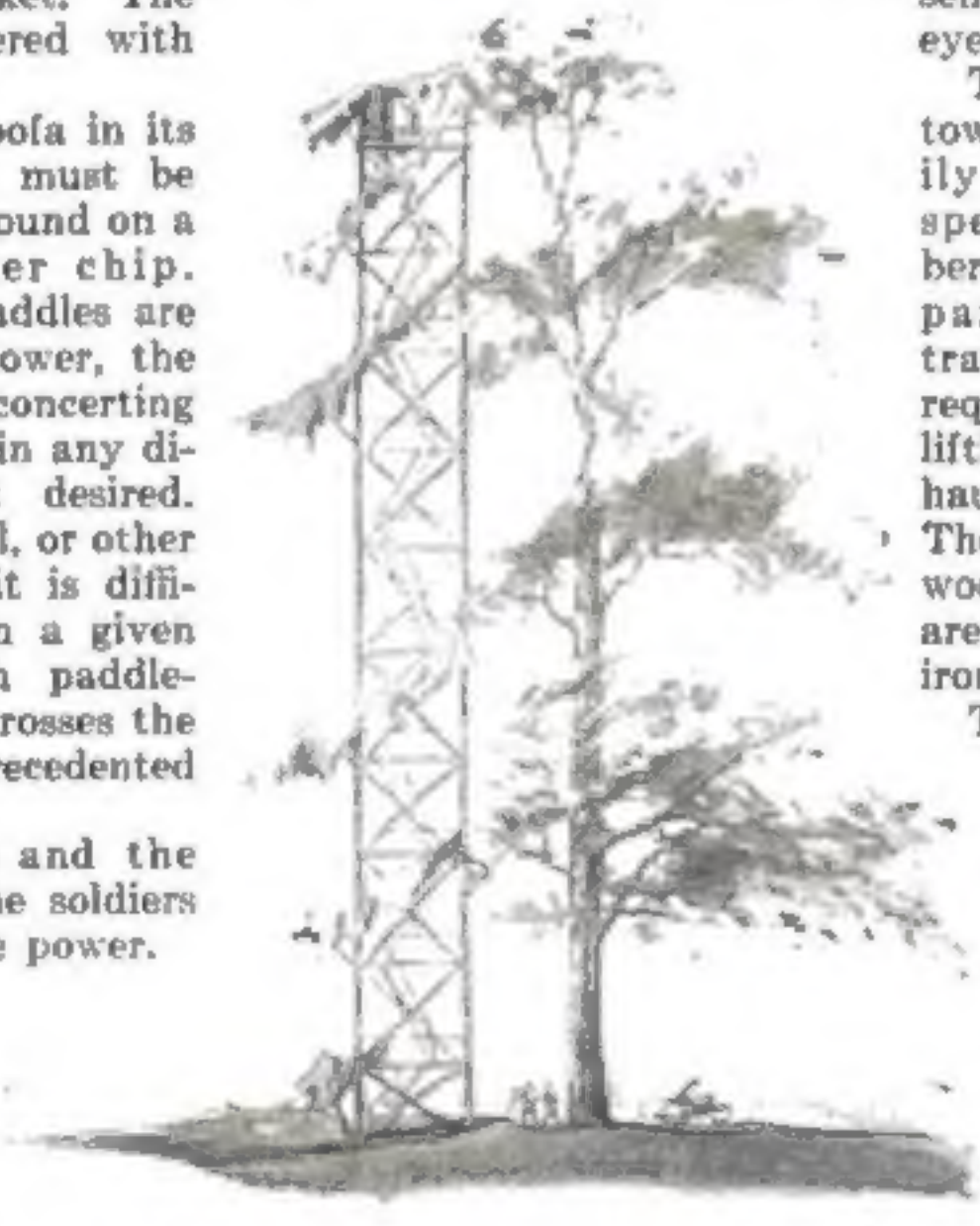
Simple cranks and the sturdy arms of the soldiers furnish the motive power.

The fleet of goofas has been duly numbered for identification and is doing yeoman service in the Far East for moving supplies.

Camouflaged Observation Towers Used in Flanders

IN low, marshy Belgium, half flooded as it now is to interrupt the course of the Germans, there is almost no natural cover for observation posts. Camouflage is a necessity.

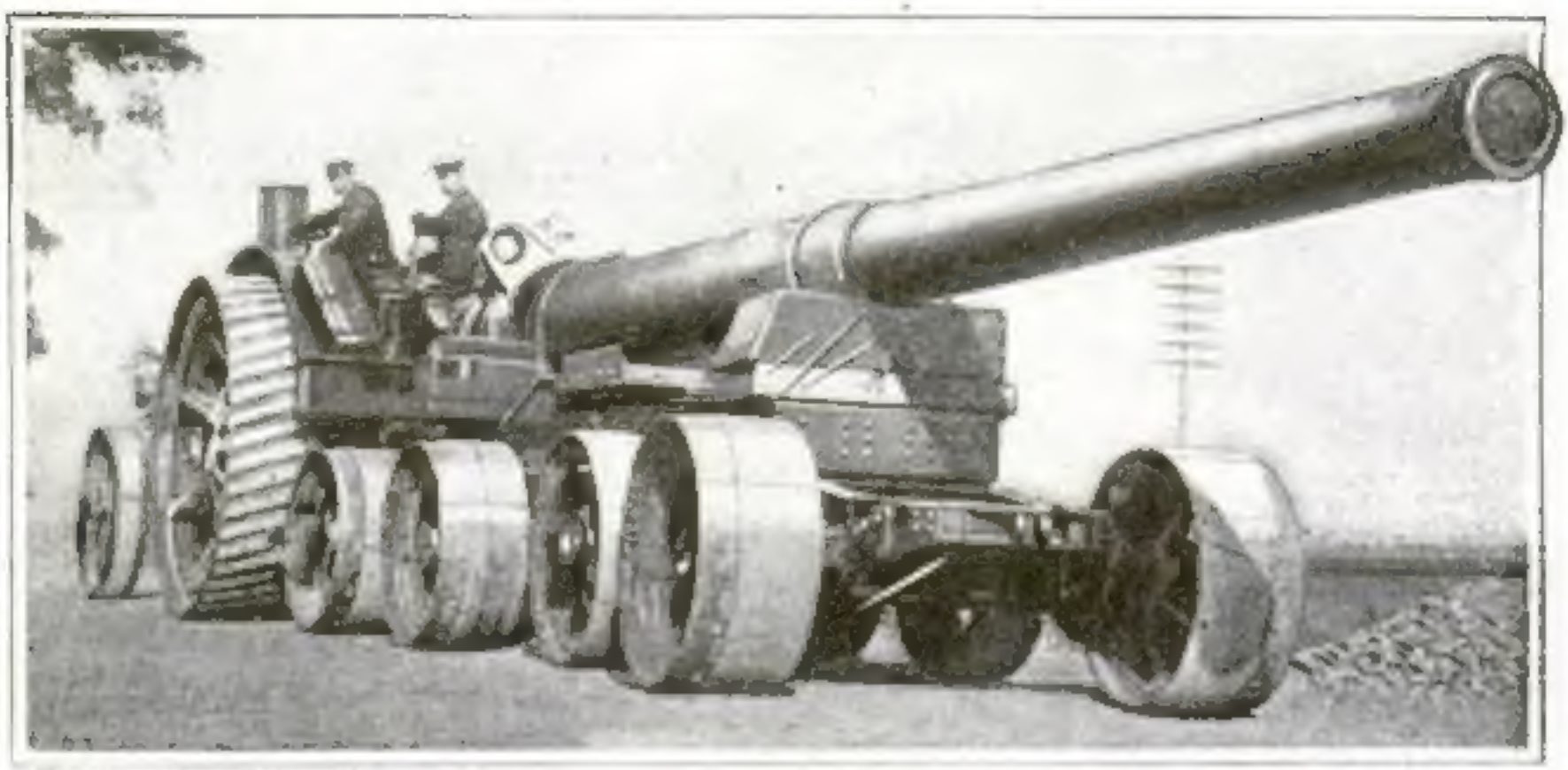
The two observation posts, here illustrated, were erected about a mile and a half behind the front lines, one at an eminence of sixty feet, the other three feet lower. A situation was chosen where there was one natural tree. The two towers are so camouflaged that a cluster of what seemed to be three trees was presented to the enemy's eye.



When is a tree not a tree? When it's an observation tower. More camouflage as practised in Belgium

These observation towers can be speedily built and as speedily dismembered. All of the parts are easily transportable, and require no special lifting apparatus to haul them into place. The material used is wood. The joists are held together by iron bolts.

The width of the towers is eight feet. On their top platforms are placed the instruments, necessary for artillery observations. Steel wire braces are attached from four angles, to steady the structure.



© Underwood and Underwood

A mammoth tractor of great power and two trailer trucks haul the monster guns to the front over the splendid roads of Flanders—roads that have been reconstructed by the Engineer Corps

How the British Hauled Their Giant Guns to the Flanders Front

THE transportation of one of the enormous guns used in the present war is a task which presents great mechanical difficulties. The weight of the guns and their great length make even their transportation by railroad anything but a simple matter. But railroads are not always and everywhere available. When the front is advanced, the big guns must be carried on to be used in the following artillery operation.

It would be absolutely impossible to transport the guns in their entirety. They are taken to pieces and transported. The gun itself, the heaviest part and the one most difficult to manage, is carried upon trailers with broad wheels, pulled by a gigantic tractor resembling an overgrown steam roller. The picture shows a twelve-inch naval gun and gives a good idea of the length and caliber of this terrible instrument of destruction which is capable to hurl tons of steel a distance of many miles.

The roads are excellent, as the Engineers follow up the advances and reconstruct them.

Swinging from a strip of paper

She Weighs One Hundred and Twenty-six Pounds, But the Paper Held

THE athletic girl in the picture, Miss Lorna E. Stewart, of Kalamazoo, Mich., is not a motion picture star doing some hair-raising melodramatic "stunt." She is merely testing the tensile strength of a certain kind of parchment paper by suspending her weight of one hundred and twenty-six pounds from a loop made from a three-inch strip of that paper.

The paper used in this test was vegetable parchment paper taken out of the stock of a manufacturing concern in Kalamazoo, Mich. It is intended for important documents, diplomas or records which are expected to last a great many years without deterioration. Such paper may be boiled, soaked, frozen, buried underground and subjected to abuse that would destroy ordinary paper, without being damaged in the least. Unlike ordinary paper, soaking in water makes the paper tough instead of soft. This is the highest quality in papers, which range all the way from this to newsprint and wrapping, and the familiar blotting paper.

Listen to the Nose Flute of the Untutored Filipino

IT is not an uncommon spectacle to see a colored man play a harmonica with his nostrils. When it is done, however, it always awakens a certain degree of wonder. Among the Filipinos a flute is never played in any other way, and it would create as much surprise in that country to see a man play a flute with his mouth. Why they see fit to play with the nostrils instead of the mouth we do not know. Moreover, they do this with the greatest ease, and can play the general run of music except the very fast rag time. Dare we perpetrate a pun and say that it must be a nose-pipe?

Nasal music of an unfamiliar kind

Traveling in the Oilfields with a Possible Earthquake

RIDING over rough country roads in a spring wagon loaded with nitroglycerin is an occupation that is not likely to appeal to the average man, yet there are those who make it their business to carry explosives and who become so accustomed to the hazardous work, that they scarcely give a thought to the risk of traveling, so to speak, with a potential earthquake.

In the oil districts of Pennsylvania, Texas or California you may meet vehicles like the one in the picture, traveling slowly along the country roads. The body of the wagon rests upon a system of springs, which absorb all sharp shocks that might cause the explosion of the nitroglycerin. The load consists of enough nitroglycerin to "shoot" several oil-wells and of the necessary tubes, tools, etc. The tubes are filled with nitroglycerin and cautiously lowered into the borehole of the well. The uppermost tube has at the top a firing head which is exploded by a falling or sliding weight, called the "go-devil" and sets off the nitroglycerin charge. From four to six quarts ordinarily constitute a charge, but larger charges are used.

© Brown and Dawson

The stock-in-trade of a "well-shooter." It consists very largely of enough nitroglycerin to raze a town

Electric Blasting Without Blasting Machine

THE safest and most convenient way of firing charges in blasting is by using the electric spark, and blasting machines for generating the required spark are in general use wherever blasting operations are carried on. Farmers, who often have occasion to do blasting of stumps, rocks, etc., but not often enough to justify the expense of purchasing a blasting machine will be interested in the suggestion offered by Mr. W. A. Saunders, New Hampshire, who made shift to fire a circuit of five charges of dynamite with a spark obtained from a dry-cell battery of his automobile, when no blasting machine was available on a certain occasion. This is a handy wrinkle to be acquainted with on occasion.

Off the Well-Beaten Paths of Tourist Travel

Street of David leading to the Bazaar in Jerusalem. Even donkeys find it difficult

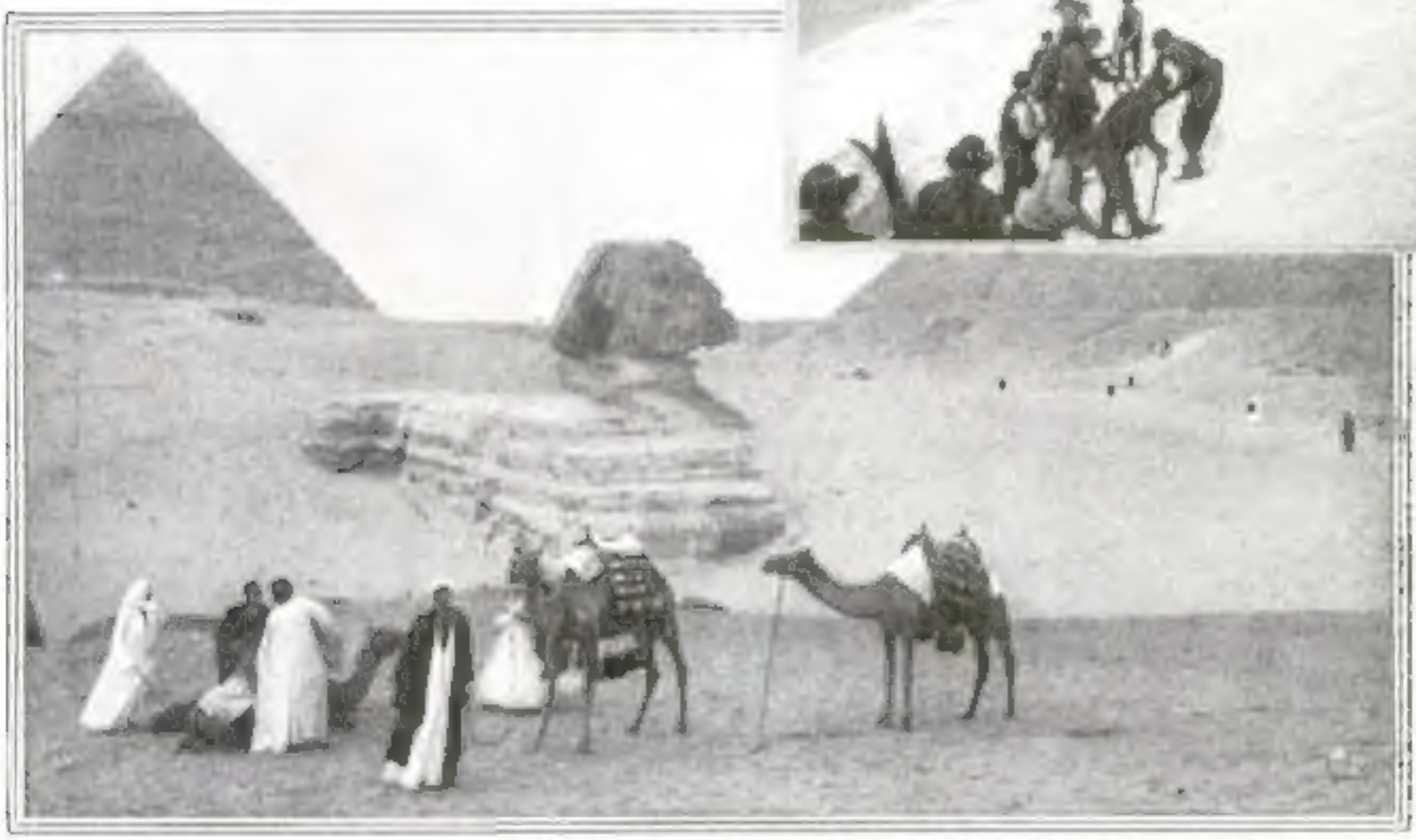
Photos © Newman Traveltalks and Brown and Dawson

Alaskan winter travel. Following a frozen river in the wilderness to its headwaters

Street in the excavated portion of Pompeii. It shows the ruts worn by the wheels of chariots in ages gone by. The city was overwhelmed so suddenly that things were caught "all standing"

Scenes One Finds "Way Out at Back of Beyond"

Snow plow at work in one of the passes of the trans-Andean Railroad, South America. In the winter snow causes much trouble



Pyramids and the Great Sphinx in the desert of Gizeh, inaccessible to automobiles

The Great Wall of China which, it is said, might be made into a fine automobile road

Zigzag walk leading to a tea house in China, warranted to keep away all the evil spirits

Raising Money for the Red Cross

These *papier-mâché* figures were placed in the Liberty Mall, Boston Common, as a mute appeal for Red Cross contributions during the recent drive in historic Boston

Photos © Underwood and Underwood

Tableau illustrating the war work of the Red Cross. This realistic group was shown on a big float during the Red Cross pageant recently held in Philadelphia

The wives and daughters of the employes of the Bronx Zoo, New York, have organized a Red Cross auxiliary and sew and knit daily in the lion house. Leo doesn't count

© Int. Film Serv.

Still Other Methods of "Getting It"

San Francisco society girls acted as "bell hops" for the benefit of the Red Cross, and are shown here displaying their "tips" stuck on adhesive tape as trophies

© Int. Film Serv.

© Underwood and Underwood

Liberal donations by passing pedestrians were thrown upon the stretcher of the Russian ambulance stationed at the New York Public Library

Assemblyman Irving W. Glover, of Englewood, N. J., auctioning a lump of sugar for the Red Cross. It was sold for $100. How the cost of living is advancing!

S. Vaselakos, a Greek peanut vendor in Washington, D. C., contributed the net earnings of his stand during an entire week to the cause of the Red Cross fund

© Int. Film Serv.

Woman-Power Takes the Place of Man-Power

Women street railway conductors in New York are employed on many lines and they are a success

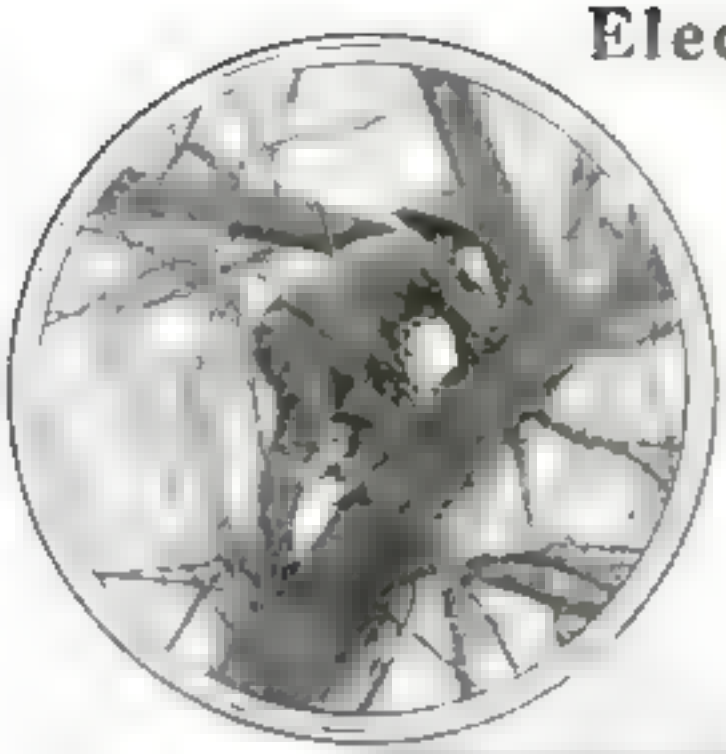
One of the "Conductresses" enthroned upon her perch behind the cash box in her car

The prospective conductors are required to go through a course at the school conducted by the street railway company for the training of their new employes

Photos © Press Illus. Serv.

Before starting from the barn in their cars on their initial trips the feminine conductors, just like their male predecessors, are handed their orders

Electrical Eavesdropping by the Signal Corps of the United States Army

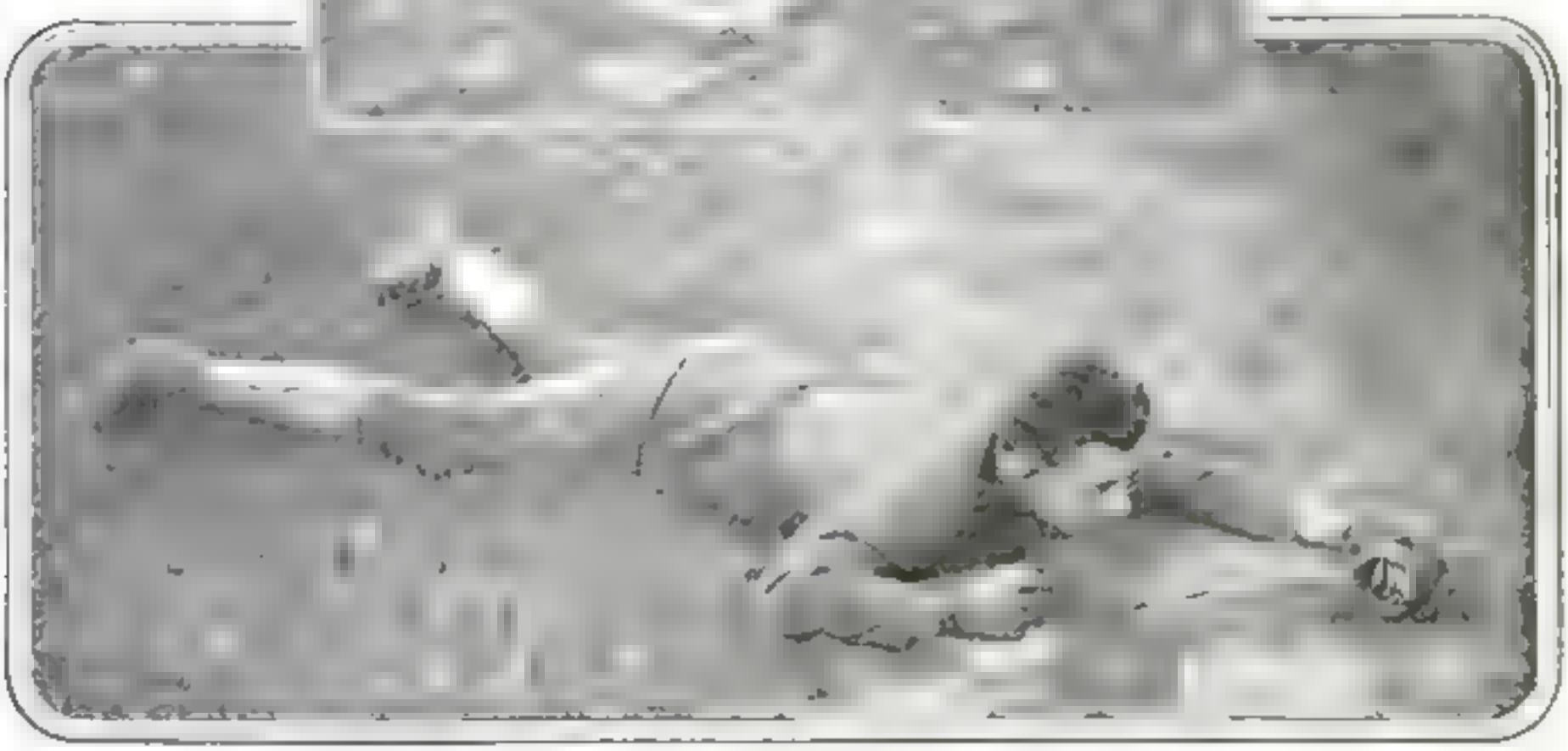


The dictagraph receivers are put anywhere they will be handy. Here is one being placed in a tree top

Listening for the sound of operations by enemy spies. This often entails a great deal of danger and discomfort

Crawling up to an enemy trench to place a transmitter, which is cunningly camouflaged in a battered tomato can

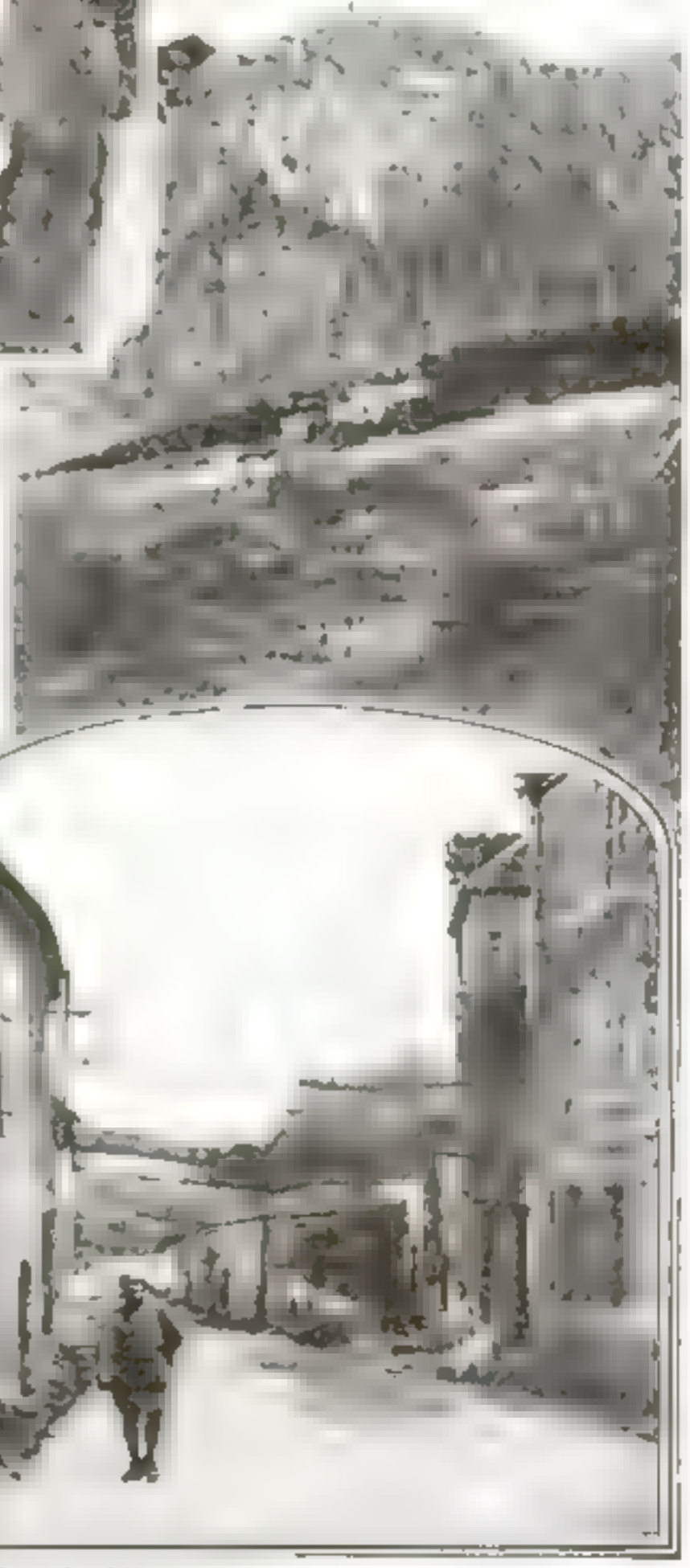
A trench receiving station where the conversation and movements overheard by the transmitter are noted



Where "distance to the view." of interesting the fine art of

Need a range of mountains? Why picture the hills are pure fabrica- mountain ranges like mushrooms

Italians building a strange and wonderful structure for the benefit of Fritz. In this branch of the war game the quotation "things are not what they seem [illegible] very aptly Any given th[illegible] he[illegible]



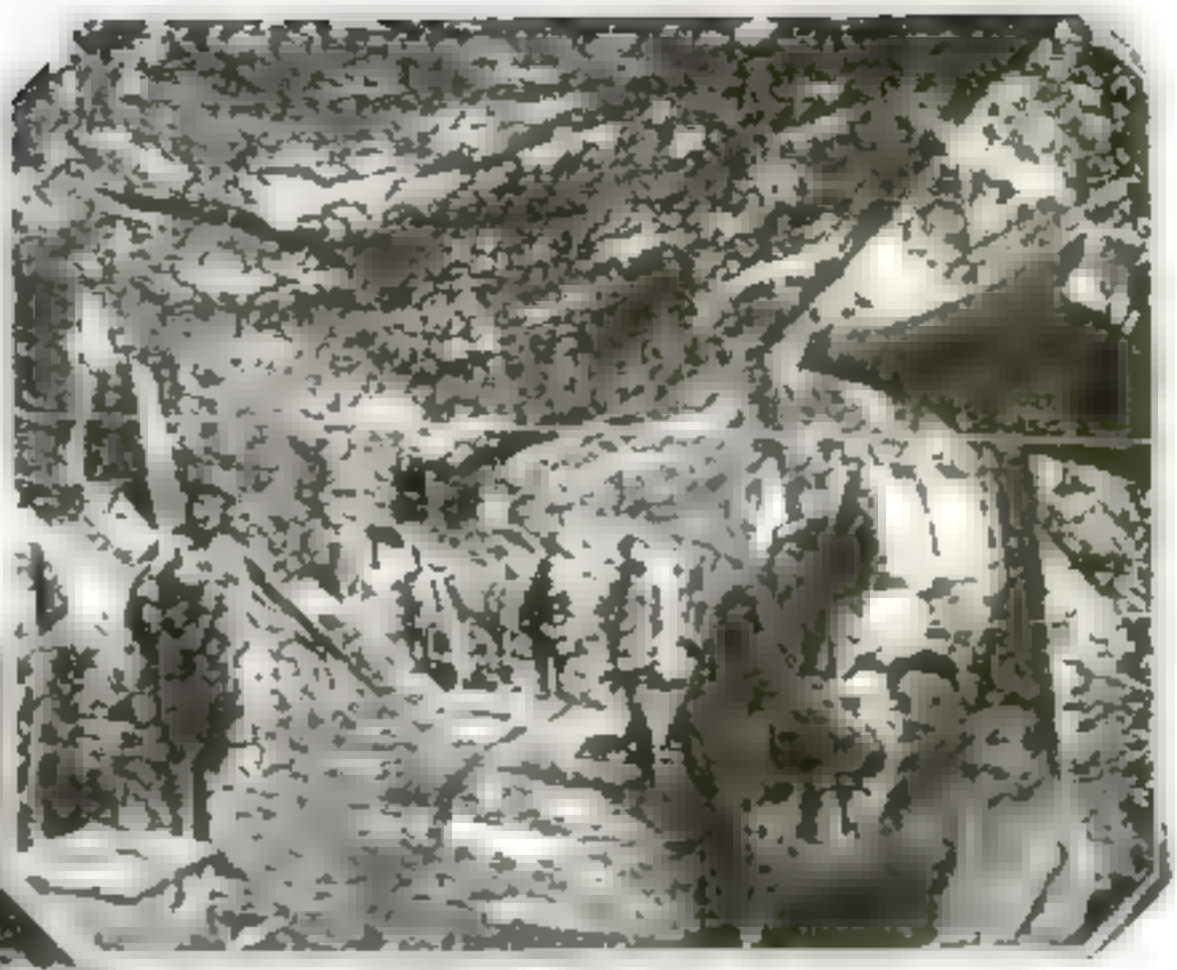
© Underwood and Underwood

A corduroy communication road with a deceptive screen of foliage. It looks crude enough here but not when seen from the sky

From an airman's point of view, this road gives the appearance of mere floating clouds, by virtue of the burlap stretched across it

lends enchantment Here is a group examples of war camouflage

certainly—right away, sir. In this tion. The camoufleurs can grow if the necessity should arise



Even dressing-stations are not immune from Boche attack, and grim experience has taught the advisability of hiding them. This particular station among the mountains is hidden by a tent-like piece of canvas, painted to match the surroundings

© Kadel and Herbert

This is an absolute work of art. It traverses the Astico Valley, and is truly making very much of a virtue of necessity

The commencement of a camouflage screen is much like the setting up of a "set-piece" on Fourth of July. Here the skeleton of a road screen is going up. Later the canvas will be applied and suitably painted with a self effacing color scheme. The object of this particular piece of protective coloring is to screen off a road so that troops and supplies can be moved along it while hidden from the enemy's direction by the skilfully painted screen

The Seductive Cigarette in the Making. Its

The girl in the picture is feeding the cigarette-making machine, spreading the cut tobacco to insure even supply to the mechanism.

Expert girl sorters carefully select from the stock the leaves which are to be combined to give the desired blending of the tobacco

The leaves selected for the blend are turned over to the cutter, who is here at the cutting machine, preparing the tobacco for the cigarette machine

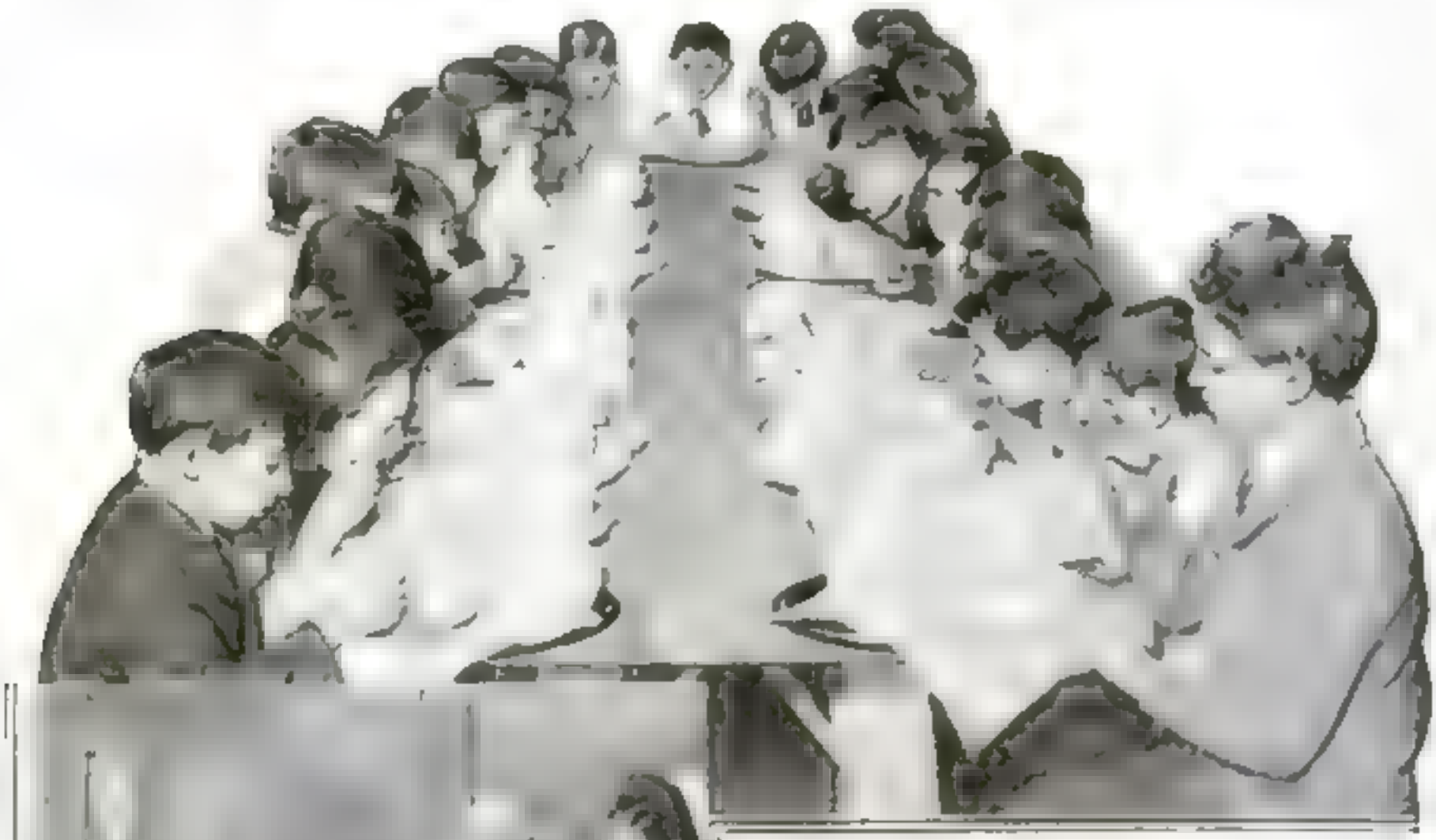
Evolution from Leaf to Finished Product

Each tobacco bale must be thoroughly inspected and classified by an expert before the tobacco can be selected for the desired blend

This shows the delivery end of the cigarette machine The cigarettes, completely finished and ready for packing, are neatly piled

The deft hands of girls fill the boxes with the counted number of cigarettes, label, wrap and pack them in paste-board containers for transit

New York's Food Scouts Commence Experiments



These children, all under weight, are being fed the correct kind of lunch every day, free, to prove the necessity of hot, balanced lunches for children. The menus are arranged by highly skilled dietitians

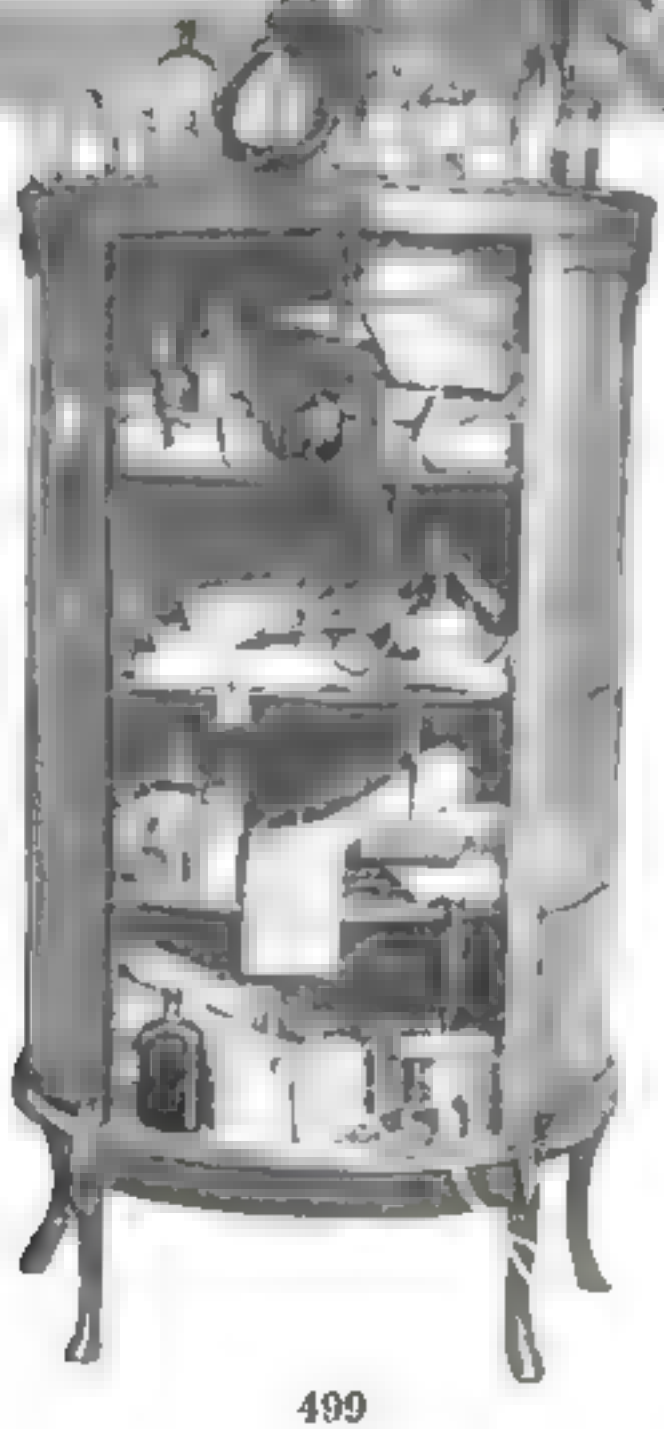
Weighing in the food scouts—all boys Dr. Morris Stark, one of the chief experimenters, is seen examining one of the boys while another is being properly weighed

"T. R." is interested in the experiment—so interested that he went and weighed the boys personally. Here he is seen "on the job." He shook hands with all the boys

The Passing of New York's Coroner's Office

Here is the safe at the old New York coroner's office containing valuables, money, etc., found on dead persons. Its custodian, Edward Doonan, is the man with the guns

These gentlemen are Messrs. LeBrun, clerk, Feinberg, coroner, and Doonan, clerk. The guns have all figured in inquests and used to make a very interesting collection



Cabinet containing poisons, razors, gas-tubes, knives, ropes, etc., with which persons have committed suicide in Manhattan. All these relics were destroyed when office closed

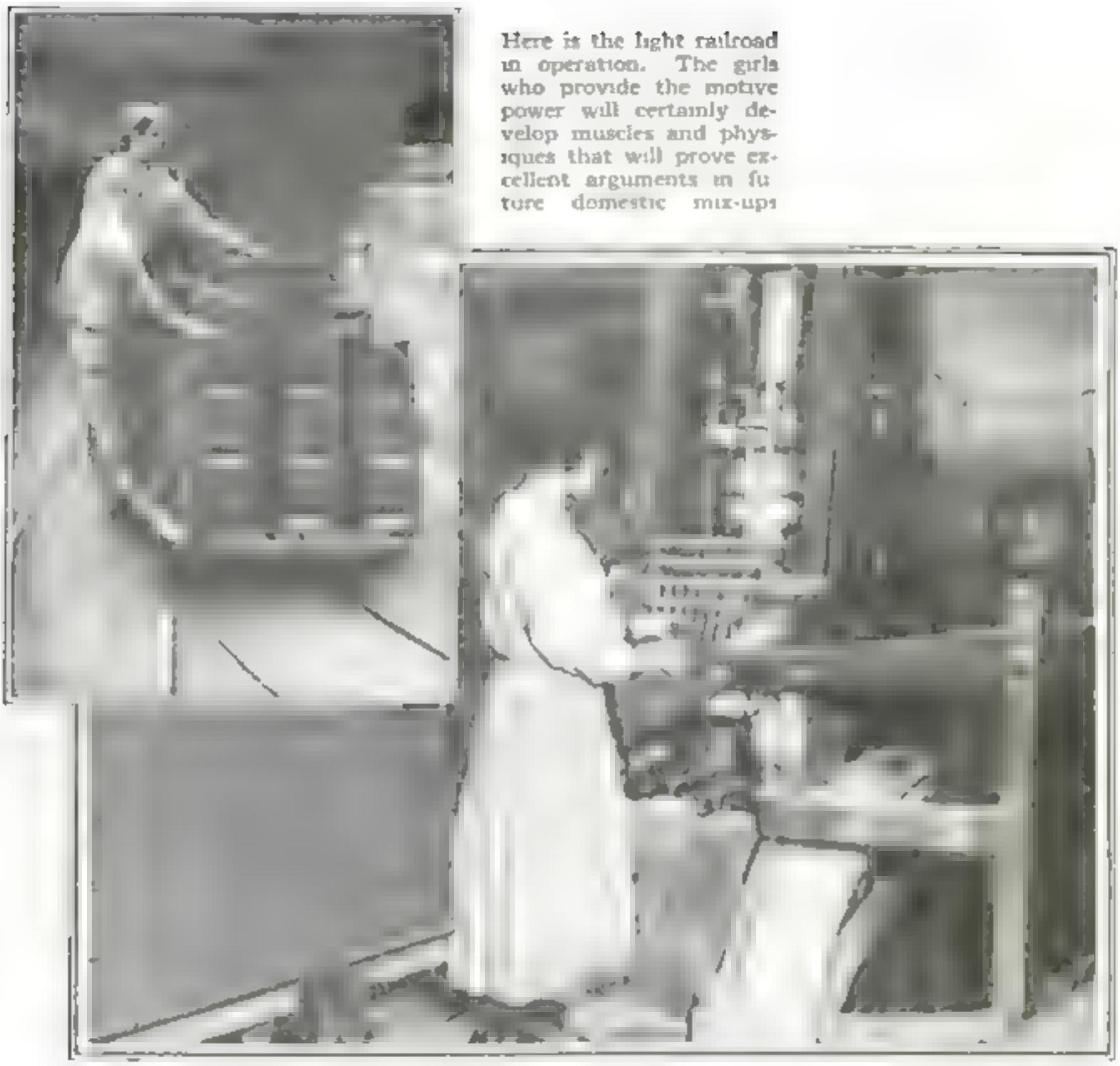
The Girl Brickmakers, at

The world's largest brick plant, at Peterborough, England, closed about two years ago owing to shortage of labor, is now reopened with women. Bricks are being put on slides which convey them to wagons

The terminations of the above slides. The girls are taking the bricks off and stacking them into the railway trucks ready for conveying to their destination. The girls are [illegible] and work goes smoothly

Here the molded bricks are being neatly stacked in the kiln ready for burning. They are brought up to the kiln on a narrow-gage railroad

Peterborough, England



Here is the light railroad in operation. The girls who provide the motive power will certainly develop muscles and physiques that will prove excellent arguments in future domestic mix-ups

The molding of the bricks is done by machine. This illustration shows how they are removed from the molding machine

And even regular laborers' work does not scare these enterprising women. Here are two husky girls trundling their barrows

No Rest for the Peaceful Oyster Even in Winter

A big haul of oysters dredged in midwinter from the beds near Oyster Bay L. I. Hooverizing other foods has created a demand for the mollusk

For the first time in history oyster dredging was carried on in winter upon the frozen Long Island Sound The picture shows the dredgers at work. Considerable amounts are obtained

Photos ⓒ Int. Film Serv

The oysters dredged up are loaded upon a sled which is pulled ashore by an automobile and then shipped to the New York market for distribution. Here we see the "rig" in operation

Shelter Bridges on the Line Near Dixmude

© Kadel and Herbert

This peculiar series of bridges constitutes a protective measure that war conditions have evolved. The railroad is a narrow gage line near Dixmude which is used for transporting supplies on low flat trucks by man power. Owing to the liability to bombardment by airplanes, it was found necessary to provide shelters, for which reason these bridges were built at intervals as a protection for both men and cars. Compare with officer for height

This glorified meter index enables Cincinnati children to fathom the mysteries of gas and electric meters

Teaching High School Pupils How to Read the Meters

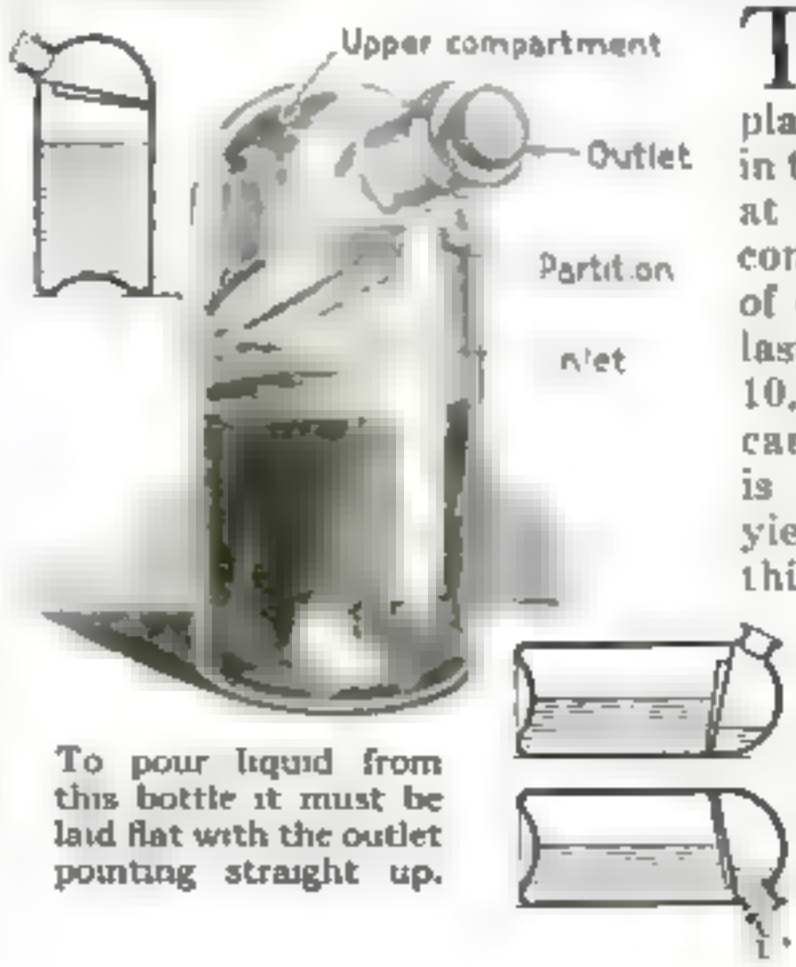
THE indicators of gas and electric meters are no longer mysteries to pupils attending the Woodward High School in Cincinnati.

Pupils of the school have constructed large duplicates of the gas and electric meter dials. By the aid of strings attached to the mechanism of the dials, gas and electric consumption readings are indicated at the will of the teacher.

Safety Bottle in Which to Keep Poisons

"QUICK, a little medicine, sister has fainted!" Many a time at night the cry has thrown the whole household into confusion and excitement. Some member of the family rushes to the medicine cupboard, seizes the bottle standing in the place that had always been reserved for the medicinal brandy and takes it to the sick-room. The bottle seized in the excitement of the moment does not contain brandy, but carbolic acid and only the timely discovery of the mistake can save the sick girl.

The poison bottle invented by Lee Howdeshell and shown in the accompanying picture would greatly diminish the possibility of such fatal mistakes. The neck of the bottle is not at the top as in ordinary bottles, but at one side. Below the outlet is an arrangement of walls which makes it impossible to pour out even a small part of the liquid in the bottle without careful manipulation. The bottle must be inclined to fill the narrow space between the walls of the partition and then back, to allow the small quantity of liquid to drain into the upper compartment which communicates with the neck. In view of the attention required to extract the contents, it would be almost impossible not to notice what they were.



To pour liquid from this bottle it must be laid flat with the outlet pointing straight up.

We Are Now Growing Our Own Camphor in Florida

THE first and only bearing camphor plantation of any size in this country is located at Satsuma, Fla. It contains over 2,000 acres of camphor trees which last year yielded over 10,000 pounds of crude camphor. This year it is expected that the yield will be many times this amount. Florida has several other plantations, which will soon come into bearing. Many more trees are being planted, and camphor may soon become profitable.

Sea-Gulls Betray the Presence of Submarine Raiders

EDWARD H. FORBUSH, the State Ornithologist of Massachusetts, advocates the protection of the sea gulls, because they are useful in detecting and betraying the presence of submarines. The gulls follow in the wake of submarines to pick up their refuse, and thus betray the presence of the U-boat to the watching aviators.

Anything to Attract Attention—The Masked Sign Girl

SINCE the suffragettes have paraded and walked the streets in small groups carrying flaring banners, no one ought to shrink from being the ham in a sign-sandwich. And yet we have some pre-suffragette conservatism left. We say so, because the shy Miss shown in the illustration hides her charms behind a black silk mask. But then (and we are assailed by a doubt) is the mask an attention-attracting device or a genuine mark of maidenly modesty? Upon this mystery the oracles are silent.

Why the masked face? Innate maidenly modesty? Or simply an attention-attracter?

© Underwood and Underwood

Statue of royalty in Odessa veiled but not destroyed—a good sign of level-headedness

Great Catherine Is Veiled But Not Destroyed by Revolutionists

IMPERIALISM and its autocratic rule have been dethroned in Russia and slowly, but surely, liberty and order evolve from political chaos by the leaders of the revolutionary factions. There are still a great many things to adjust and the completion of the task will require decades of hard work. It is not likely that the work of reconstruction will be accomplished altogether without friction, for, it must be borne in mind, there are still many persons in Russia who adhere to the imperialistic system of government.

It speaks well for the revolutionists of Russia that they have displayed, so far at least, remarkable moderation in their acts and have refrained from mere vandalism. Nowhere have they wantonly destroyed monuments or memorials commemorating the deeds of former Russian rulers. The picture, for instance, shows how considerately the revolutionists in Odessa treated the magnificent memorial to Catherine II. in their city. They did not injure it, but hid it from sight by wrapping the entire monument with heavy canvas. Acts like this prove that the Revolution is not at all the blood-mad orgy some people think.

No, they're not fumigating an orchard. The puff of smoke is a target for artillery practice

Our Artillery Shoots at Curling Smoke for Practice

"SOMEWHERE in the United States" our artillerymen are practising. They have to have something to shoot at. Recently ingenious soldiers rigged up the apparatus shown in the accompanying illustration. It consists of a long pole at the end of which is a container for holding two ounces of black powder. This is ignited by pulling a string. A percussion cap is set off. The resulting puff of smoke simulates a bursting shrapnel closely. Somewhere in the distance are a line of artillerymen, who want to get the range. As the cloud of smoke bursts in the air, it represents within certain limits the entrenched position of the enemy. As he sees the smoke curl upward, the commanding officer gives his directions to the gunners. The gun crews immediately answer with dummy rounds of ammunition. As the bombs go off in different quarters and at different heights, they see to it that the guns are trained to bear on the point where the enemy fire originates, and not on the actual place where the cloud of smoke is observed. In this way they get accurate training, and more complete preparation for actual service "over there."

It's Beginning to Rain, So Bang! Goes the Window

AN automatic device which takes care of the windows of a house or apartment, and closes them when it begins to rain, has been perfected by L. M. Phelps of Philadelphia. It is quite automatic and its action is said to be positive. In his device a loop lever, connected with a stationary rod attached as a permanent fixture to the lower corner of the upper window sash, is held in position by a narrow strip of blotting paper. So long as the paper is dry it is rigid enough to hold the delicately adjusted lever, but a single drop of rain will so soften the paper that it allows the loop of the lever to fall and thus to release the pressure of the lever against the lower sash. Since the sash is weighted with a bag of sand or small shot, it will drop and close the window against the rain.

Here is an automatic window-closer operated by a strip of blotting paper

In addition to acting in case of rain it can be made to work at a predetermined time by alarm-clock.

Introducing the Moropus

Nature mixed up a horse, a rhinoceros and a giraffe and obtained—a moropus

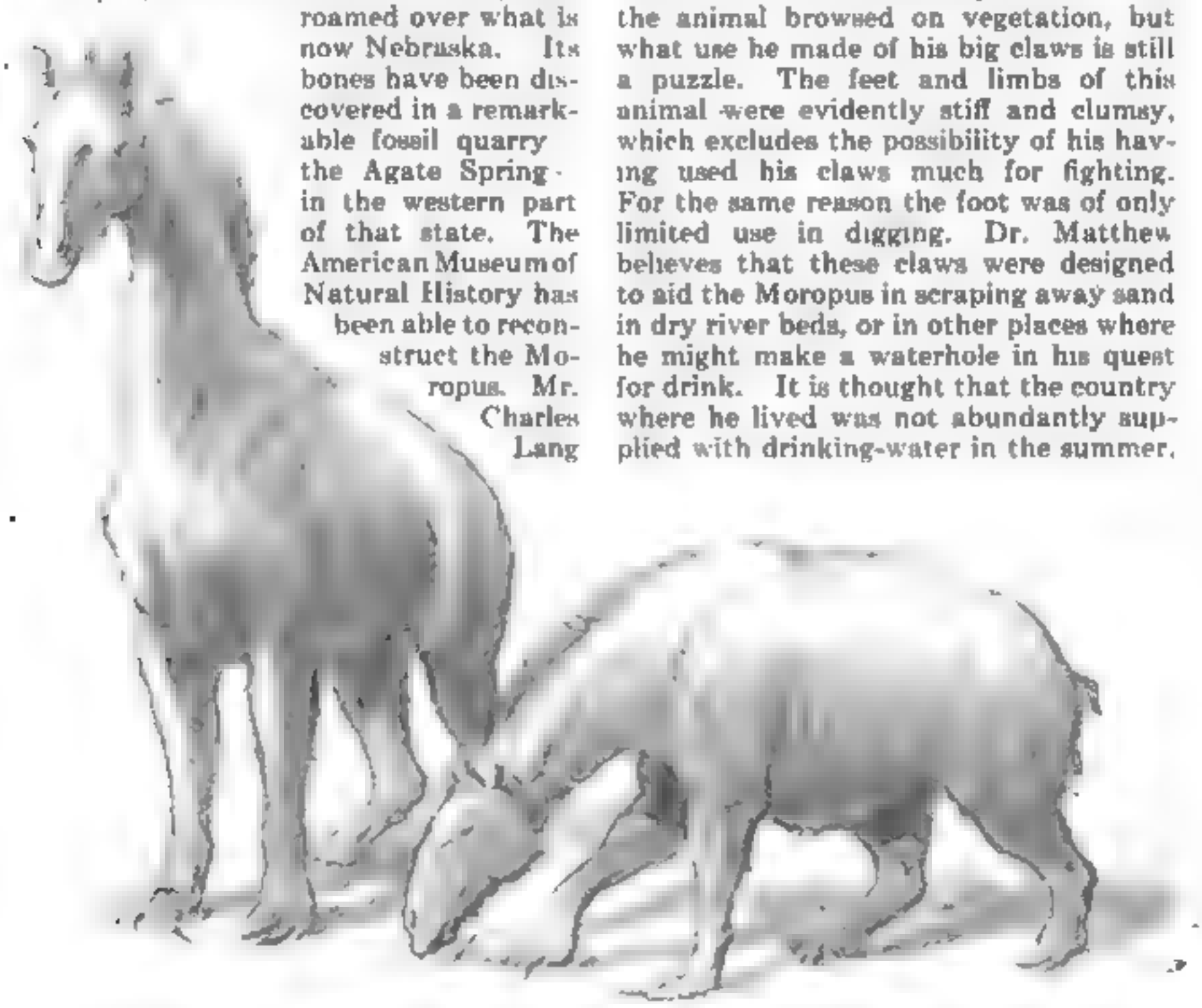
A CENTURY ago, Cuvier, the great French scientist, in laying down what is now known as his "Law of Correlation," stated that horns and hoofs distinguished only vegetarian animals. Claws belonged to flesh eaters, according to his law, and no animal which subsisted on a meat diet had hoofs.

This law of Cuvier's was accepted for decades. Recently the discovery of a remarkable fossil has disproved it. In prehistoric days there was a grazing animal which had powerful claws instead of hoofs.

This animal, which has been called the Moropus, was an American beast, that roamed over what is now Nebraska. Its bones have been discovered in a remarkable fossil quarry the Agate Spring in the western part of that state. The American Museum of Natural History has been able to reconstruct the Moropus. Mr. Charles Lang mounted the skeleton of the beast. A sketch of it as it appeared has been prepared by Mr. Erwin S. Christman who worked from directions given by Dr. Osborn and Dr. Matthew.

The animal is a strange combination of horse, rhinoceros, camel or giraffe, but it differs from them in having an enormous claw on each front foot and a smaller claw on each hind foot. The peculiarity of this possession lies in the fact that grazing animals do not require means of attack such as claws. They need their hoofs solely for moving about and not for attacking prey or for digging

The teeth of the Moropus show that the animal browsed on vegetation, but what use he made of his big claws is still a puzzle. The feet and limbs of this animal were evidently stiff and clumsy, which excludes the possibility of his having used his claws much for fighting. For the same reason the foot was of only limited use in digging. Dr. Matthew believes that these claws were designed to aid the Moropus in scraping away sand in dry river beds, or in other places where he might make a waterhole in his quest for drink. It is thought that the country where he lived was not abundantly supplied with drinking-water in the summer.



One would imagine this animal to be called a "rhinocerhorse" or a "girafferos" or something like that, but his real name is Moropus and he lived at a time when the world was young

The Eyes in the Air

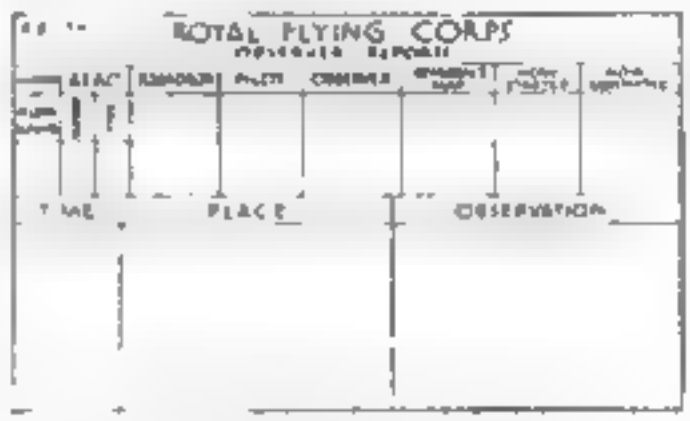
All aboard for a reconnaissance flight over the German lines

By Aviator Henry Bruno

Late Imperial Royal Flying Corps, Canada

IN the British Flying Corps there are two kinds of air reconnaissance work—Corps and Army. Corps reconnaissance is carried out by a single airplane and army reconnaissance by squadrons of machines numbering not less than five and as many as thirty. To understand just what a Corps reconnaissance flight means it will be necessary for me to transport you to an active section of the Western battlefront during the summer.

A two-gun, two-seater Sopwith fighter is trundled out of a hangar. While the pilot is inspecting the map of the territory over which he is to fly, the observer receives his orders to get information on the movement of enemy troops, motor transports, trains and the direction in which they are going, over an area of not more than ten thousand yards in front of the allied position. A duplicate of the pilot's map and writing materials are ready in the observer's seat.



When the observer returns from his trip over the enemy lines he fills out a report on a blank like this and turns it in to general headquarters

As the final order is given, the plane ascends and wings its way over the lines towards the enemy. The pilot climbs rapidly, keeping a wary eye open for enemy air-raiding squadrons. The usual height at which he operates is from six thousand to ten thousand feet.

Nearing the German lines the observer eagerly scans the ground below through powerful glasses. If you were to look through these same glasses you would see mile after mile of shell-marked earth every mile seemingly the same as the next. But to the observer every foot of that ground holds information worth noting, information which he is willing to give his life to get. The pilot doesn't linger over the battlelines. His work is still to be done back of the enemy's trenches.

Far below the plane is a thin wisp of white smoke. To the uninitiated it means nothing; but the men in the plane know that it is a train winding towards the front. Its position is quickly marked on the map.

What's That Cloud of Dust?

A white road next occupies their attention. The pilot drops the plane a little utterly oblivious to the anti-aircraft shells bursting around him. One part of the road is obscured by a black smudge and a cloud of dust. A regiment of infantry is on the march. Why infantry and not cavalry? The dust cloud tells. It would hang in the rear of cavalry and the men and horses would look like black specks. It is such deductive reasoning as this that an observer has to be trained to make.

The observer estimates the number of troops by figuring what space they occupy. A little further on, three black specks move rapidly down the road. Motor trucks in a hurry. All this is recorded by the watchful observer who becomes more keen as the minutes pass.

The plane is over a railroad station now. Are there any parked motors? How many cars are on the rails? Several working parties below run for cover when the plane hovers over them. Evidently this is an important depot as seven "archies" hurl shells skyward in an effort to scare the aerial visitor away. A shell bursts near by. The plane rocks from the explosion. Then, as the pilot shuts off the motor, the machine dashes earthward in a nosedive. No! he is not hit. The observer just wants a closer view of the depot. Nearer and nearer the plane swoops, with machine-guns from the ground adding to the din from the anti-aircraft guns. Five hundred feet from his objective he flattens out, opens up the

Underwood and Underwood

Soldiers in One of the Winding Trenches of a Shell Pitted Battlefield

Military information of the kind which this picture contains is carefully noted by the observer who engages in Corps reconnaissance. Considerable deductive power is necessary

motor, and is off again homeward bound.

Again the battlelines come into view below, and the observer looks out for new trenches. Sure enough he sees several, and marks their position carefully on the map; also whether they are traverse or communication trenches. The condition of the barbed wire entanglements next engages his attention Where they are,

© Kadel and Herbert

Army reconnaissance observers study enemy airdromes, make a note of the number of hangars and planes on the ground and watch the movements in towns and large encampments

broken by shell fire he sees smudges and spots, all of which are faithfully recorded.

Camouflage or a Battery—Which?

The shells come thick and fast, but the pilot is an old hand at the game; he'll stick till the work is done. Cleverly hidden on the ground, the observer sees some small narrow-gage tracks, terminating in several pits. Has he discovered a new enemy battery, or is it camouflage? He must see the gun flashes before being sure. There they are! One! Two! Three! Four! Five! He also sees the blast marks in front of the battery. Now he is satisfied. Signalling the pilot he focusses his glasses again—this time in the direction of home.

A few minutes later, watchers at the R. F. C. airdrome see the reconnaissance plane winging its way back home, and shortly it settles safely to earth outside the hangar.

The observer fills out his report on a blank similar to the specimen shown on page 508 and turns it in to G. H. Q. (General Headquarters). The filing of this report marks the conclusion of the Corps reconnaissance.

Army reconnaissance squadrons carry cameras and take photographs at many different points. One of these squadrons will often fly several hundred miles into enemy territory in order to gain desired information. Instead of writing down single items as in Corps work, the observers report the general impression gained from the entire trip. The reason for this is that there are sure to be many movements which are not important, when a large territory is covered. Army reconnaissance observers study enemy airdromes, make a note of the number of hangars and planes on the ground and watch the movements in towns and large encampments. Rivers and canals are also looked for, particularly if there are any ships on them. The size and type of boat must be reported; also to which side it is nearer.

What the Observer Looks For in Army Reconnaissance

The railroads, highways, woods and towns are studied as in Corps reconnaissance, except that an especial look-out is kept for hostile kite-balloons, "blimps," and aircraft. Each squadron is escorted by scout machines whose duty it is to keep off attacking planes. The pilot of an Army reconnaissance plane must not give offensive battle to the enemy. The scouts are there for that. Should an enemy plane get through the formation, however, it is the observer's duty to see the enemy first and open fire. If he doesn't it probably means that his plane will "crash," and not only will he and his mate go down to death, but the records for which they risked so much will be destroyed.

Army reconnaissances are carried out at from one to twelve thousand feet, and strict orders are issued that there be no straggling. A favorite pastime of the Germans is to send three or more machines into the air to look for our stragglers. Perched high in the sky, generally about eighteen thousand feet, these hawks watch and wait. Suppose a fighting scout has motor trouble or wants to look around a little. He swings out of line and the others close in. Soon the squadron is almost out of sight, homeward bound with the precious reports. The scout flies along at about fourteen thousand feet. Then down from their perch swoop the Germans. The rat-tat-tat of their machine-guns warns the allied pilot of his peril. He may down one or possibly two of his antagonists, but in the end he crashes to earth the loser in an unequal fight. That is why R. F. C. orders read "Do not straggle; to do so means the loss of pilot and plane."

In Corps reconnaissance the pilot does not run such a risk, as he flies over a comparatively small territory and can generally dash for home if attacked. Of course he has to contend with anti-aircraft shells and the possibility of a surprise attack from the air; but for all that his lot is easier than that of other pilots who venture far into enemy territory.

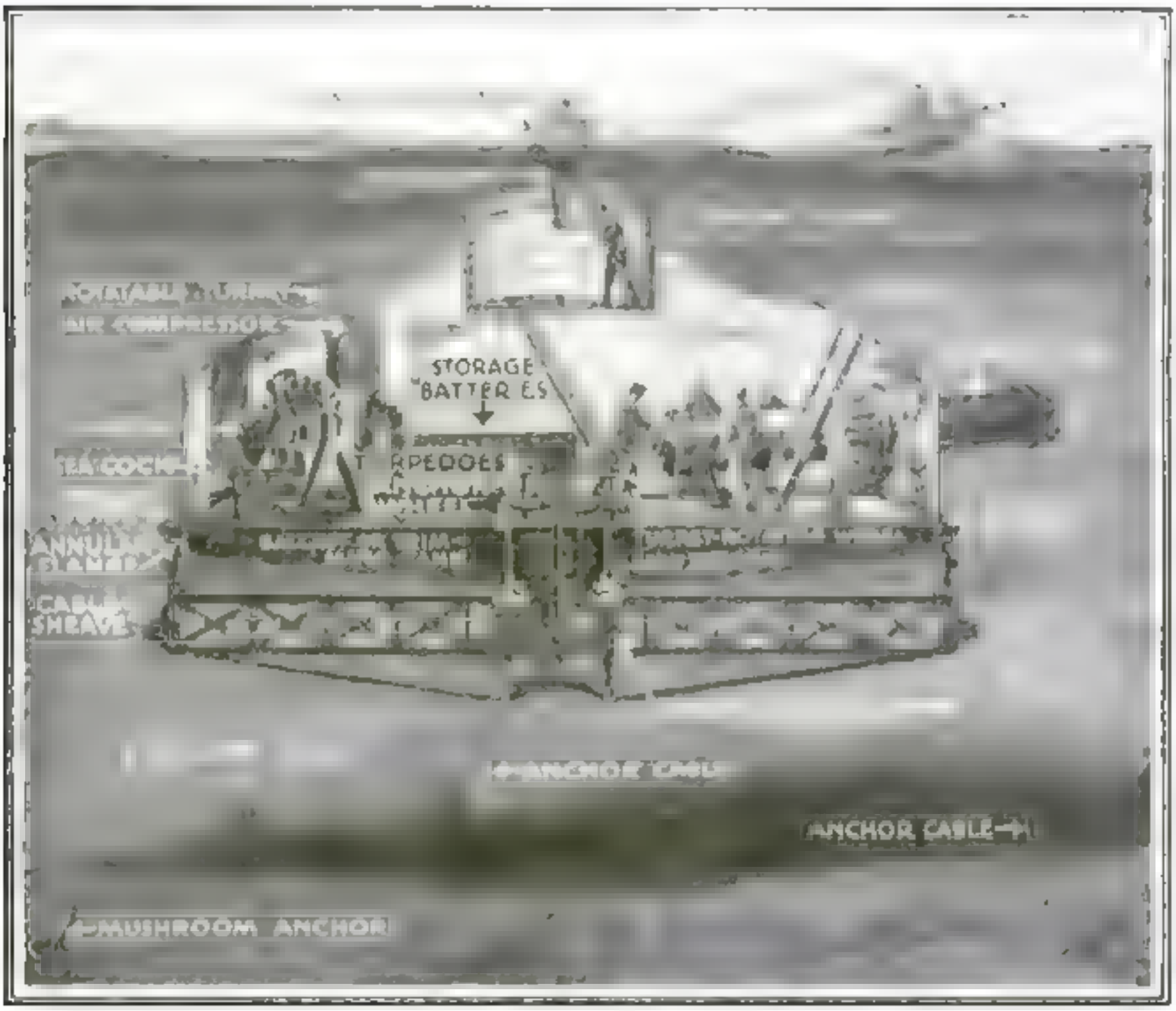
You will be astonished to learn that the average age of R. F. C. pilots doing reconnaissance work is twenty and of observers twenty-two. It requires young blood and muscle to stand the strain, risk and excitement of this branch of the air service. That results so far have more than justified expectations, is a tribute to the skill and bravery of these youngsters.

Food Animals Killed on One Railroad in a Year Would Feed 70,000 Soldiers

A PLACARD posted on the premises of a certain railroad which runs through the Cotton Belt states that during the twelve months ending June, 1917, 2,792 head of cattle, horses and sheep were killed by the trains. This is the equivalent of one million pounds of food, and would be sufficient to feed seventy thousand soldiers for thirty days. This line operates only 1,809 miles of track, and that lies in the cotton country, where food animals are not produced to any large extent. What the returns would be for such states as Missouri, Iowa, Illinois, or Kansas one can only surmise.

Submersible Forts to Protect Our Coast

They are conceived as anchored, floating turrets, capable of discharging torpedoes at the enemy's ships



The turret-shaped submersible fort can be rotated upon a substructure anchored by means of four mushroom anchors. Its only armament is represented by a single torpedo tube

IT is a short time before sunrise. The sea is fairly calm and reflects in undulating patches the gorgeous colors of the sky already visible in the East. The rhythmic sound of a whirling propeller is faintly audible. It is still far away, but approaching rapidly.

Fifteen minutes later the graceful yet forbidding form of a warship emerges from the light morning mist. It is an enemy raider headed for the roadway to one of America's important Atlantic ports.

On board the hostile ship the tension is great. There may be mines and submarines, coast batteries and other defences. The deck watches have seen nothing suspicious and cautiously the raider continues its way toward the roadway.

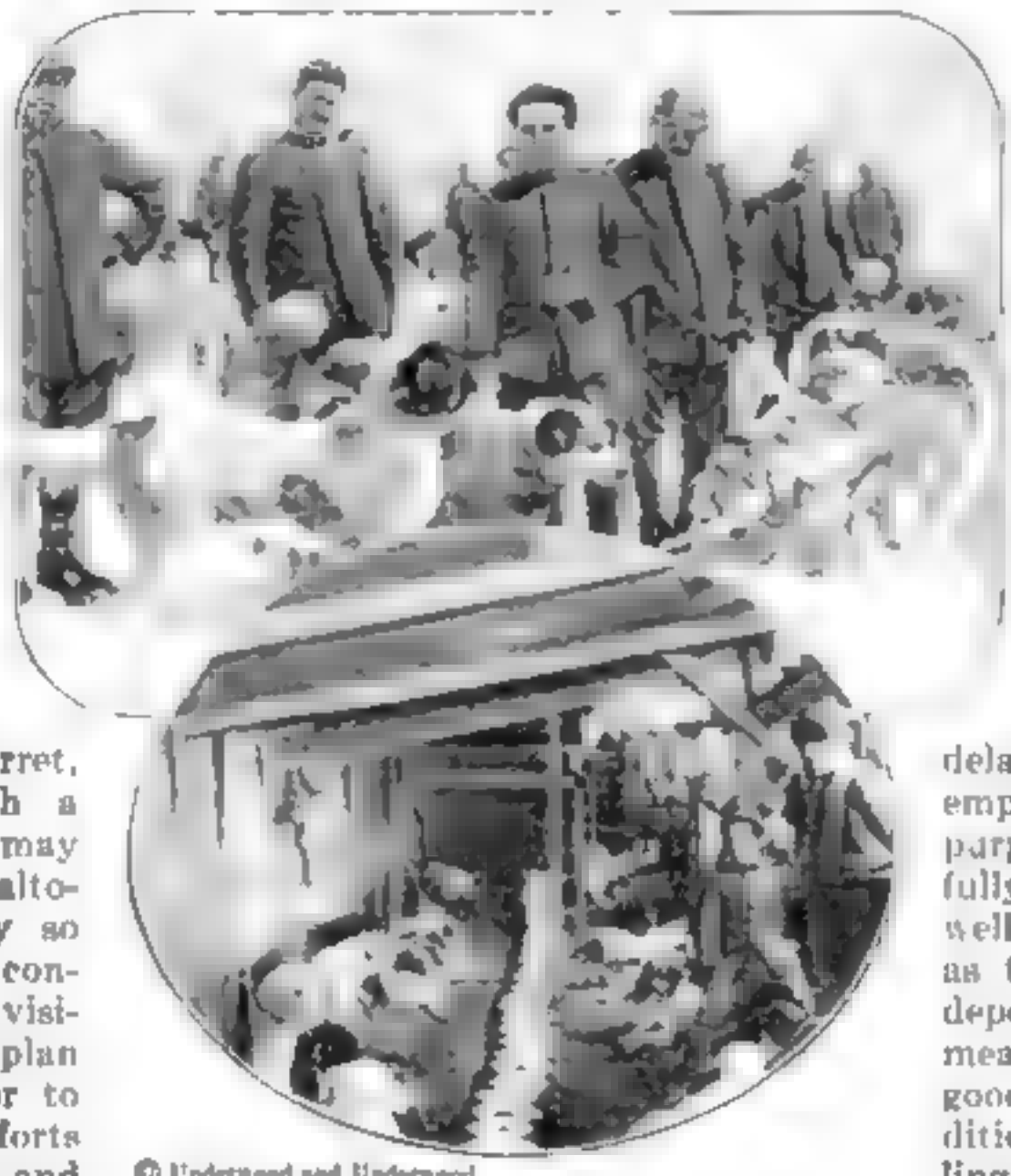
The hostile craft has just passed a few hundred yards from a piece of wreckage, a waterlogged barrel, when the watcher notices a sharply defined line of bubbles rapidly approaching the ship.

"Torpedo coming, look out!" he yells with all his might. It is too late. Before the course of the ship can be changed the torpedo strikes amidships. A tremendous explosion makes the water rise like a

fountain and descend again upon the shattered and fast sinking hull of the ship. A few moments later all is over.

The torpedo, which was launched from the tube of a submersible anchored fort, the periscope of which was camouflaged by the barrel, has done its work.

An episode like that pictured here, in brief, would be entirely within the range of possibility, should the government adopt the idea of a submersible fort in accordance with the invention by J. A. Steinmetz of Philadelphia, recently patented. The fort, in the form of a turret, provided with a conning tower, may be submerged altogether or only so far that the conning tower is visible. It is the plan of the inventor to anchor such forts along the coast and near harbor entrances as a protection against hostile ships. The mechanism for winding and unwinding the anchor cables, for turning the turret upon the ball-bearings of its anchored base and for launching the torpedoes is controlled from inside the turret and storage batteries supply power for the airpumps, and for lighting the crew's quarters. For cases of emergency a supply of compressed air is stored in a pressure tank in the turret. The forts would be self-contained and would carry sufficient supplies to enable them to carry on between the periodical visits of a supply ship.



© Underwood and Underwood

Two interesting pictures of "dogs of war" They are used for finding wounded men

Italian War Dogs Are Well Cared For and Well Trained

DOGS, at least some dogs, have proved themselves so valuable for military purposes during the present war, that they have been added to the equipment of every army engaged in the struggle. The main purpose for which they are used is the finding of wounded soldiers after an engagement or skirmish in difficult territory, so that they may be carried to the field hospitals immediately behind the lines without delay. The dogs employed for that purpose are carefully trained and well taken care of, as their usefulness depends in a large measure upon their good physical condition and their willingness to work.

Various breeds of dogs have been tried by the governments of the belligerent nations, but only a few of them have been found of value. The dogs shown in the pictures are used by the Italian army in its difficult campaign in the mountains. They are of several different breeds, with the St. Bernard type predominating. St. Bernard dogs have been used in relief work in the high Alps for centuries and have proved themselves hardy, efficient and trustworthy even when working by themselves. The sagacity and courage of the St. Bernards are wonderful. They seem, at times, almost human.

Those of us interested in science, engineering, invention form a kind of guild. We should help one another. The editor of the POPULAR SCIENCE MONTHLY is willing to answer questions.

Hiding Ships with Paint

How protective coloring causes Fritz much waste of torpedoes. It is camouflage at its best

By Robert G. Skerrett

THE gun afloat, whether upon a naval craft or an armed merchantman, drives the submarine to cover beneath the waves when it approaches its prey close enough to discharge the torpedo. The U-boat commander must, therefore, keep track of his moving target. At best, a periscope is a poor substitute for the naked eye or the binocular vision made possible by good field glasses. The periscope is one-eyed, and this entails very definite and unsatisfactory limitations. These facts must be kept in mind in order to evaluate the real purpose of marine camouflage.

Marine camouflage differs radically from camouflage ashore where the character of the background facilitates concealment. It is a simple thing to cloak a gun with a screen of foliage or to mottle it with paint so that its contours disappear. The ship afloat, except through the agency of a smoke screen, cannot veil its identity. Under certain conditions of light, the vessel stands vividly silhouetted against the sky, and even when the atmospheric contrast is not so sharp, the ship can be seen rather distinctly though painted a single tone of gray.

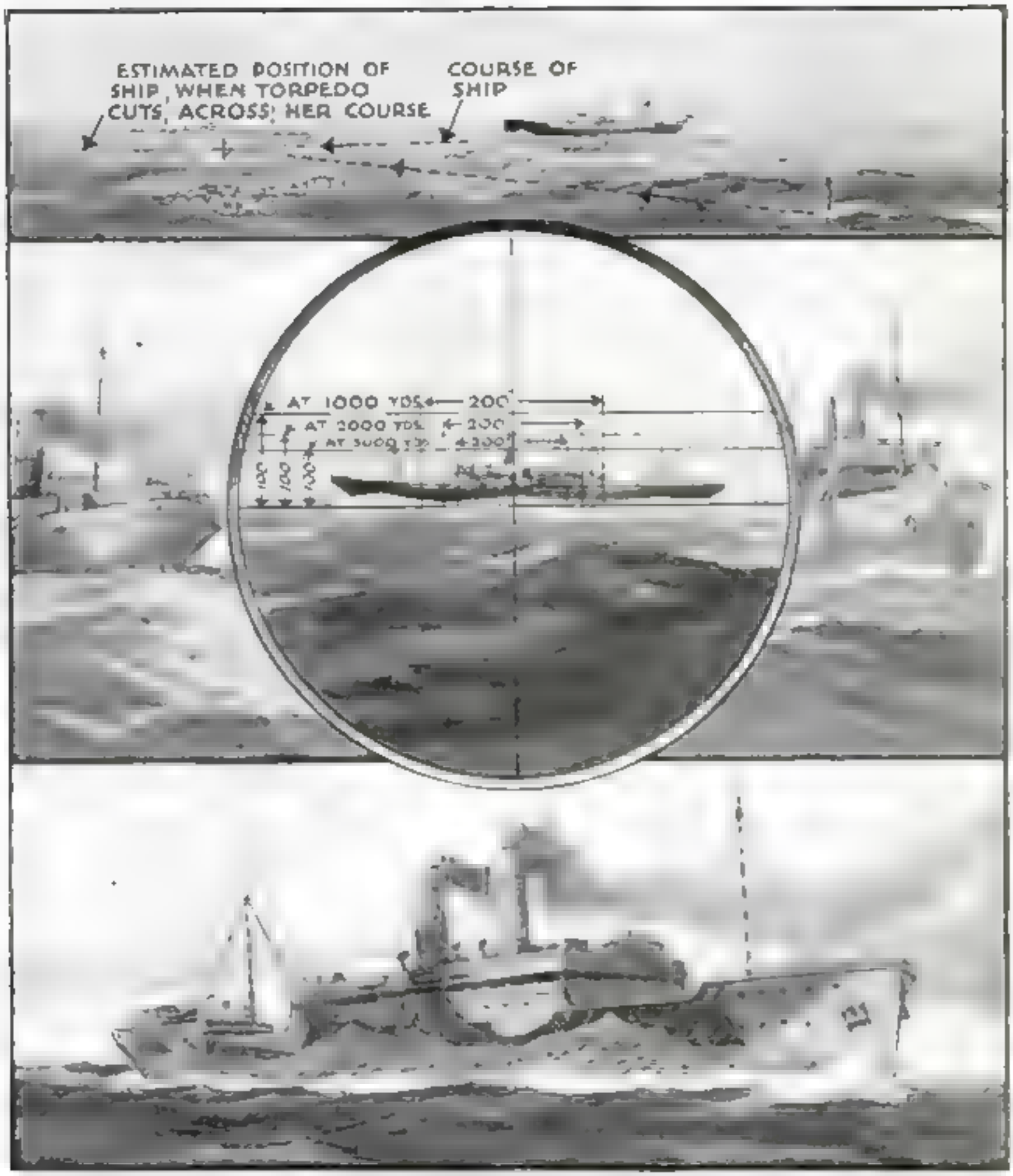
Atmospheric gray and paint-brush gray are two fundamentally different things so far as vision or visibility is concerned. The latter is the product principally of black and white pigments, while the atmospheric gray is a vibratory effect resulting from the movement of red, green, and violet rays of light. The quality of this gray alters from hour to hour as one or the other of these chromatic rays predominates, and, manifestly, no single pigmentary gray could accommodate itself to these changes. Finally, the character of a ship is indicated by her body form and her upper works—details that are emphasized by high lights and strongly contrasting shadows.

The submarine in the barred zones seeks to close in upon its quarry during the dusk of early morning, or the close of day or after nightfall, especially if the moon helps to make the enemy craft discernible. The camoufleur therefore tries to reduce the visibility of vessels during the periods of dim or half light, and, curiously enough, the more scientific of these men employ really vivid coloring for the purpose. They paint their ships with apparently meaningless splotches of strong pink, blue, and green. The patches become prominent agreeably to the predominating light ray at the time, and serve to obliterate those familiar details or forms for which the observer looks. Not only that, but normally shaded areas are purposely painted light, and the visual effect is flat and confusing. There is dazzle and loss of definition in fairly strong light, and, during periods of twilight, atmospheric vibration induces a gray tone that is so nearly akin to the sea background that craft painted in this marked fashion actually become invisible at a mile!

Upon the field of a periscope there are a number of horizontal lines as well as vertical ones. The horizontal lines are spaced to represent a prescribed height at distances say of 1,000, 2,000, or 3,000 yards, while the vertical lines are spaced to indicate definite intervals at those different distances so as to determine the speed of a vessel passing across them. The U-boat commander, in order to launch his torpedo with a fair chance of hitting his target, must know how far off the enemy ship is, whether her course is bringing her closer or taking her away, and approximately how fast she is moving. With these factors fairly gaged, the torpedo is pointed far enough ahead of the target to allow for its time of flight and the advance of the enemy craft.

The commander of the submarine must also be able to measure the height of his quarry from her true waterline to the top of her smokestack, which is a reasonably

Mimicry on the High Seas



Camouflage at Sea

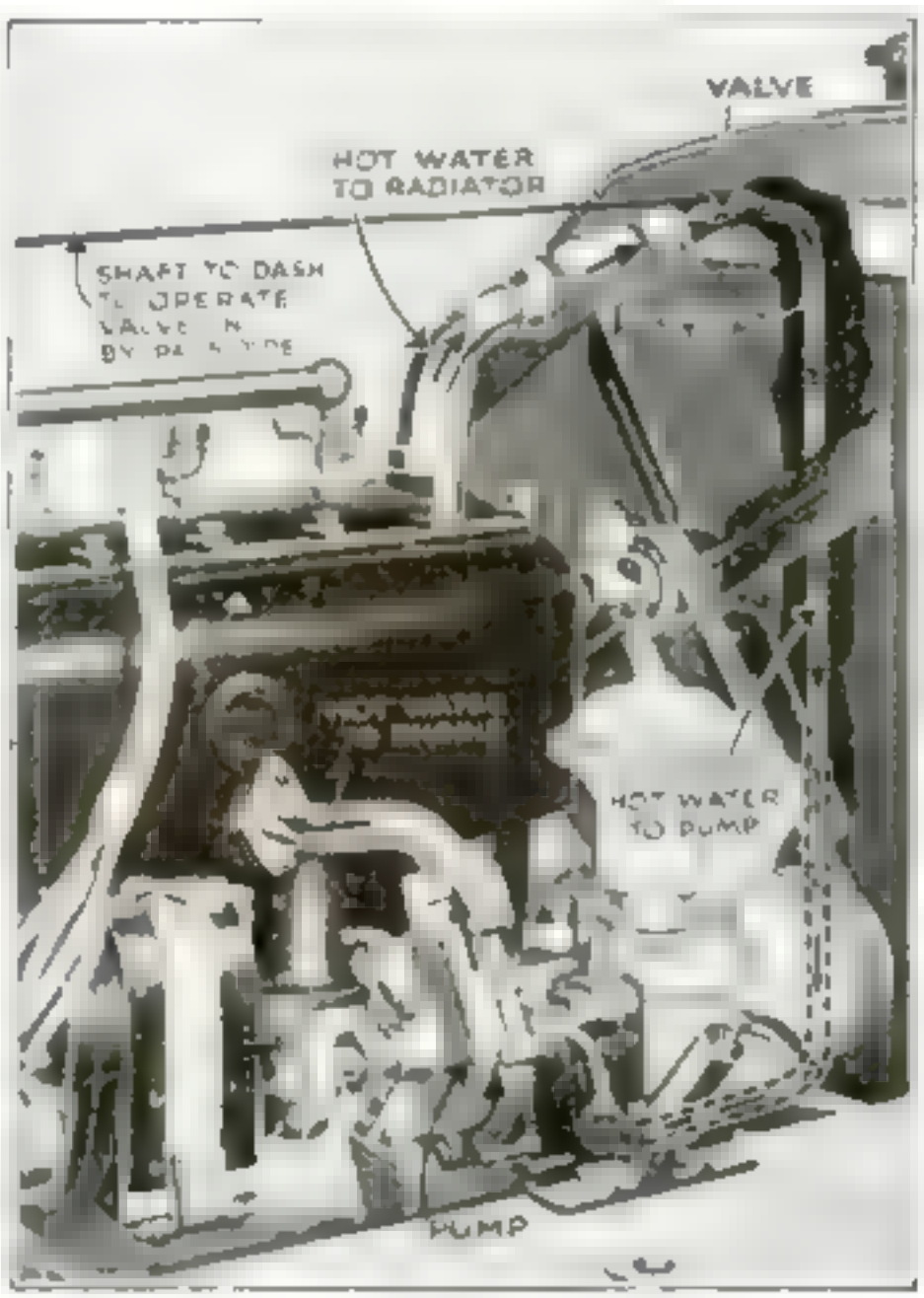
The first illustration shows how closely related the problems of a submarine commander are to those of a duck hunter. He must estimate the speed and course of his target and shoot enough ahead to allow for them. The centre picture shows the appearance of a ship at 2,000 yards, seen through the periscope of a submarine under ideal conditions. The range is determined by the height of the smokestack above the waterline. The two side illustrations are examples of the way the camoufleur changes the light and shade on the hulls, funnels, etc. of vessels, thereby confusing an observer both as to the length of the ship and the angle of her approach or departure. The ordinarily high lights are toned down, and the naturally dull portions are thrown up by painting them in bright colors. At the bottom is seen a complete camouflaged boat, and one that was painted by a master-hand. The whole idea is to give the impression of a sinking ship, and to merge the ship proper into the background. It will be noticed that the dark shaded patches on the hull would convey at a distance, the impression of a funnel and waterlogged hull, while the sham "sea" merges into the real sea and makes it appear that the alleged steamer is in a sinking condition. This particular instance is a most ingenious one. A more common one is to paint the hull of a smaller vessel of radically different dimensions on the hull of the boat, or to "paint off" the stern and raise up the apparent waterline.

constant figure in the run of commercial freighters, and may be pretty accurately estimated in the cases of other larger merchant ships or well-known types of naval vessels. Any coloring that will tend to obliterate the actual waterline or conceal or confuse the top of a steamer's smokestack will deceive the observer in his effort to determine the distance or range of his target, and, therefore, throw him out in calculating how far his torpedo must travel in order to score. Also, any coloring that destroys the outlines of the ship and makes it hard to observe her movement across the periscope's vertical lines so as to estimate her speed, will introduce another element of error.

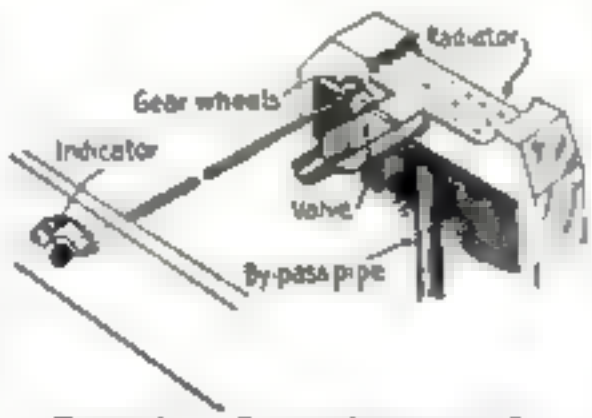
It has been determined by careful investigation that the eye tires in the course of a minute or two when watching a moving target steadily through a periscope even in broad daylight; and the eye so fatigued becomes erratic in judging both range and speed. It should be evident, then, that marine camouflage as we have developed it in this country is calculated to hasten visual fatigue and to so bewilder the U-boat commander, when he can see one of our vessels, that his torpedoes will be likely to go wide of their mark. We may change the old adage "To err is human, to forgive divine" to "To err is human to increase the error is angelic" in this case.

Save Gasoline With This Device for Controlling Engine Temperature

GASOLINE is not what it was five years ago. It is becoming heavier, so that it is more and more important to control engine temperatures automatically. Otherwise the fuel will not be properly vaporized and gasoline will condense in the manifolds and cylinders and destroy the greasing properties of the lubricating oil. The by-pass arrangement shown in the accompanying sketches is a simple way of controlling the temperature.



An arrangement that makes sure of the vaporization of the heavier gasoline of these days



Details of mechanism for actuating the valve from dash

Inside of the radiator at the rear is a separate vertical pipe. This pipe enters the lower radiator tank at the bottom. An elbow at the top of the pipe has a plain shutter valve which can be opened or closed so that the water returning from the engine can be sent to either the vertical pipe or to the top tank of the radiator. The operation of the valve is controlled by the car driver by means of a rod and two meshing gears so that in cold weather only a portion of the cooling water may be sent through the radiator or all of it through in hot weather when additional cooling is required.

This little improvement will add greatly to the starting-up capabilities of the car, particularly in cold weather, as the gasoline is always easily vaporized.

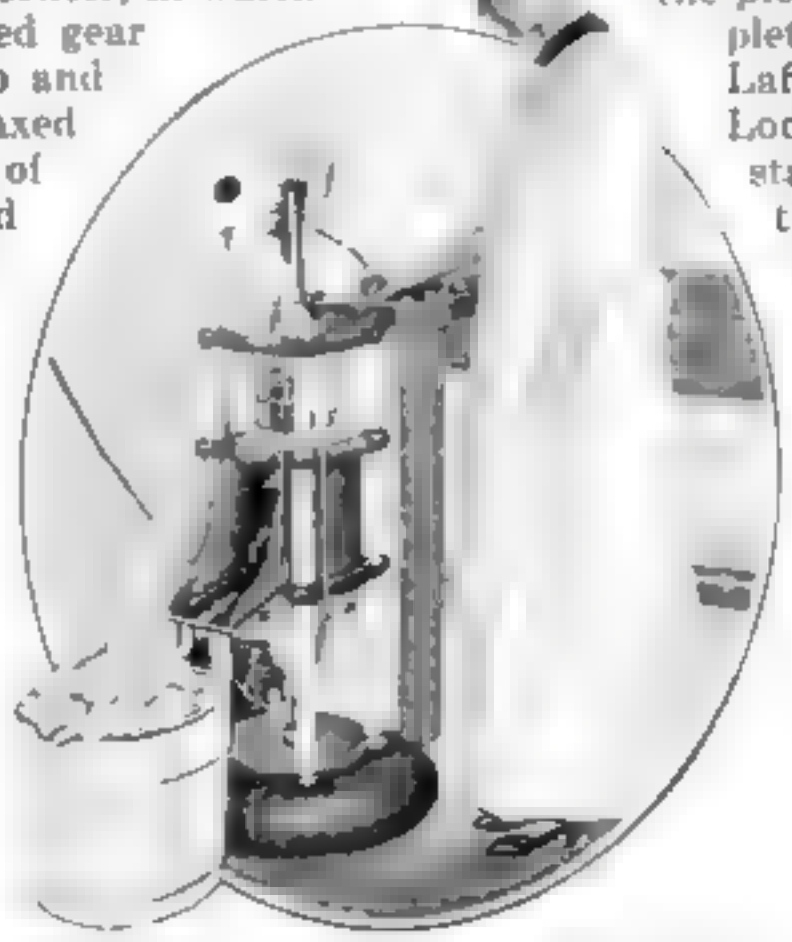
The Tick Was the First Insect Disease-Carrier to be Caught

ARSENIC treatment and starvation are gradually destroying the fever-tick which has been such a cattle-pest in the southern states.

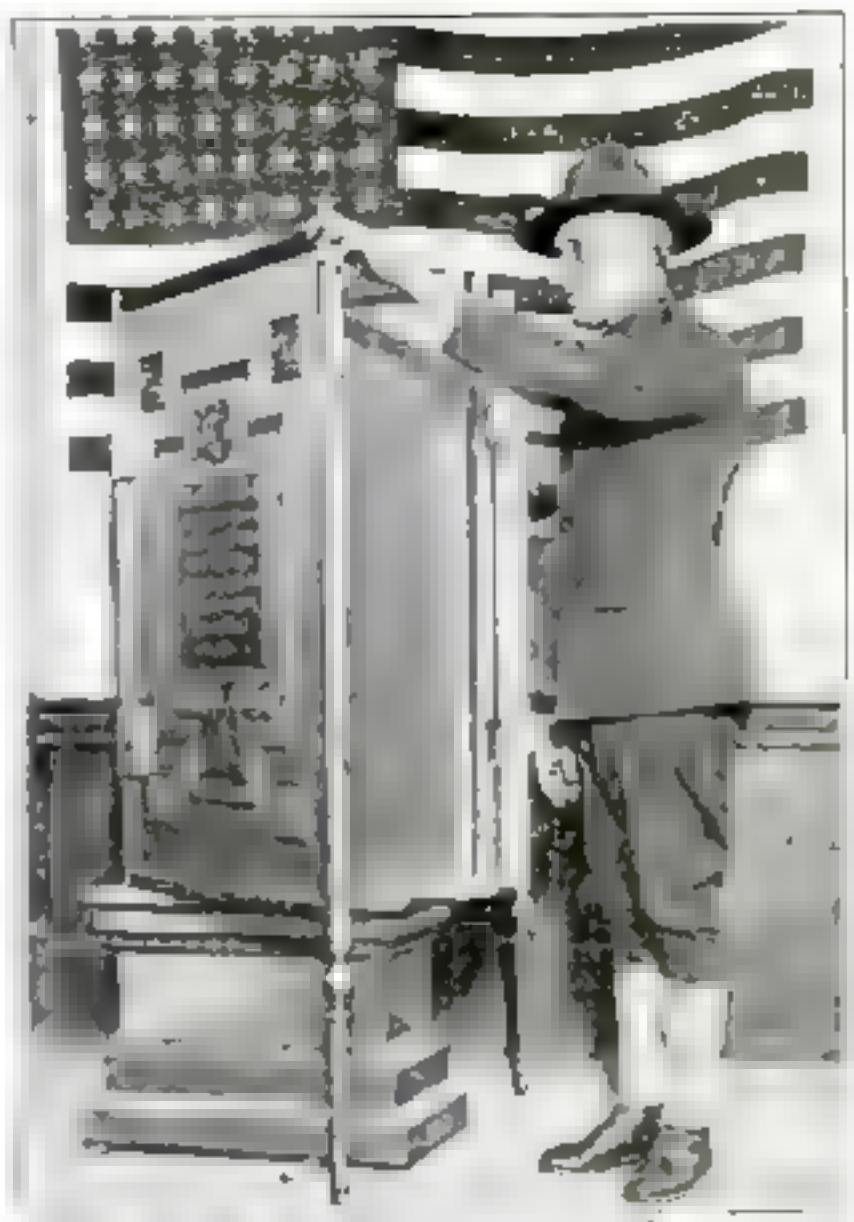
The tick, however, has served a useful purpose. When the Bureau of Animal Industry, of the Department of Agriculture, discovered that this little insect carried disease germs from one animal to another, it was the first step which led to our preventive sanitation, which is putting an end to mosquitoes, house flies, rat-fleas and other disease-carrying parasitic insects.

Wrapping Taffy by Machine at the Summer Resorts

HOW many times at the beaches or other summer resorts have you seen girls, and even men, wrapping the famous salt water taffy, kisses, chocolates and other candies? But times have changed, and munitions are more important than candies. Our manpower and woman-power must be conserved. The mechanical candy wrapper shown in the accompanying illustration offers one method of conserving our resources in this direction. It is electrically driven and consists of a small vertical stand having a cylindrical drum at its center, in which is placed a small toothed gear device which moves up and down and wraps the waxed paper around the pieces of candy. At each upward movement, the paper is inserted between two adjacent pieces of candy, and on the downward movement one piece is wrapped up and the ends twisted as shown. The attendant has only to feed the machine, which will wrap as many as one hundred pieces a minute. The use of the machine also saves much of the handling.



This little machine wraps candy more quickly than you can count the output



A unique memorial belonging to the Elks. It is a great bronze book five feet high

Chicago Elks Install a Bronze Memorial Book

THE magnificent bronze memorial book shown in the picture was recently completed by Mr. Robert C. Lafferty for the Chicago Lodge of Elks, No. 4. It stands five feet high and the fourteen pages of it will give space for twenty-one hundred names. The leaves can be taken out and placed in a vault.

Formerly the custom prevailed of erecting tablets and slabs to commemorate events and persons of importance. This proved too cumbersome and will now be superseded by the memorial book shown in our picture.

Dropping Death from the Skies

The bomb dropper and his murderous winged weapons which deal quick and ghastly death

By Carl Dienstbach

Photos © Kadel and Herbert

HARDLY had the airplane been adopted as a military weapon some four years before the outbreak of the great European war, when the possibilities of bomb dropping began to be considered. To the general public at least, it seemed easy to wipe out a fort, to demolish a bridge, or to blow up a battleship by the simple expedient of dropping on it a hundred pounds of high explosive. Engineers knew better. Long before the first Zeppelin flew over London, it was pointed out that it was hard to hit a target on the ground from an elevated platform moving at fifty miles an hour and more, because allowances had to be made for deflecting winds for the horizontal motion acquired by the bomb from the airplane. To hit a target the plane's height and speed over ground had to be known with almost impossible accuracy, and even if known, an infinitesimal hesitation in releasing the bomb would spoil the aim. A truly super-human sense of time was demanded. The difficulty, only vastly exaggerated, is the same as that which a hunter experiences in hitting running or flying game by aiming ahead of the target. Whether the target moves swiftly or the gun and the missile have a fast motion of their own, aiming ahead causes all the trouble.

Modern "fletched" airplane bomb. Note streamline form, size, and weight, as shown

On the whole, the public has been more far-seeing than military engineers. It reckoned with moral effects in its own unreasoning way rather than with physical principles. Bomb-dropping has become an indispensable mode of attack. The civilians of all the warring powers protest against it in vain. Germans denounce the "baby killing" tactics of the Allied aviators as hotly as England denounces the German slaughter of defenseless woman and children. Whether or not fortified places are bombed, civilians invariably suffer. A dozen bombs may be aimed at a munitions factory. One, perhaps, finds its mark. The rest are scattered over a residential quarter with an effect too ghastly to be described. Aim at a powder mill and you hit a hospital.

As the war progressed, bombing became more accurate, although the misses still far outnumbered the hits. The reason for this increased accuracy is revealed in the truly remarkable photographs of French bombs which we publish herewith and which have been permitted to reach this country by a lenient censor.

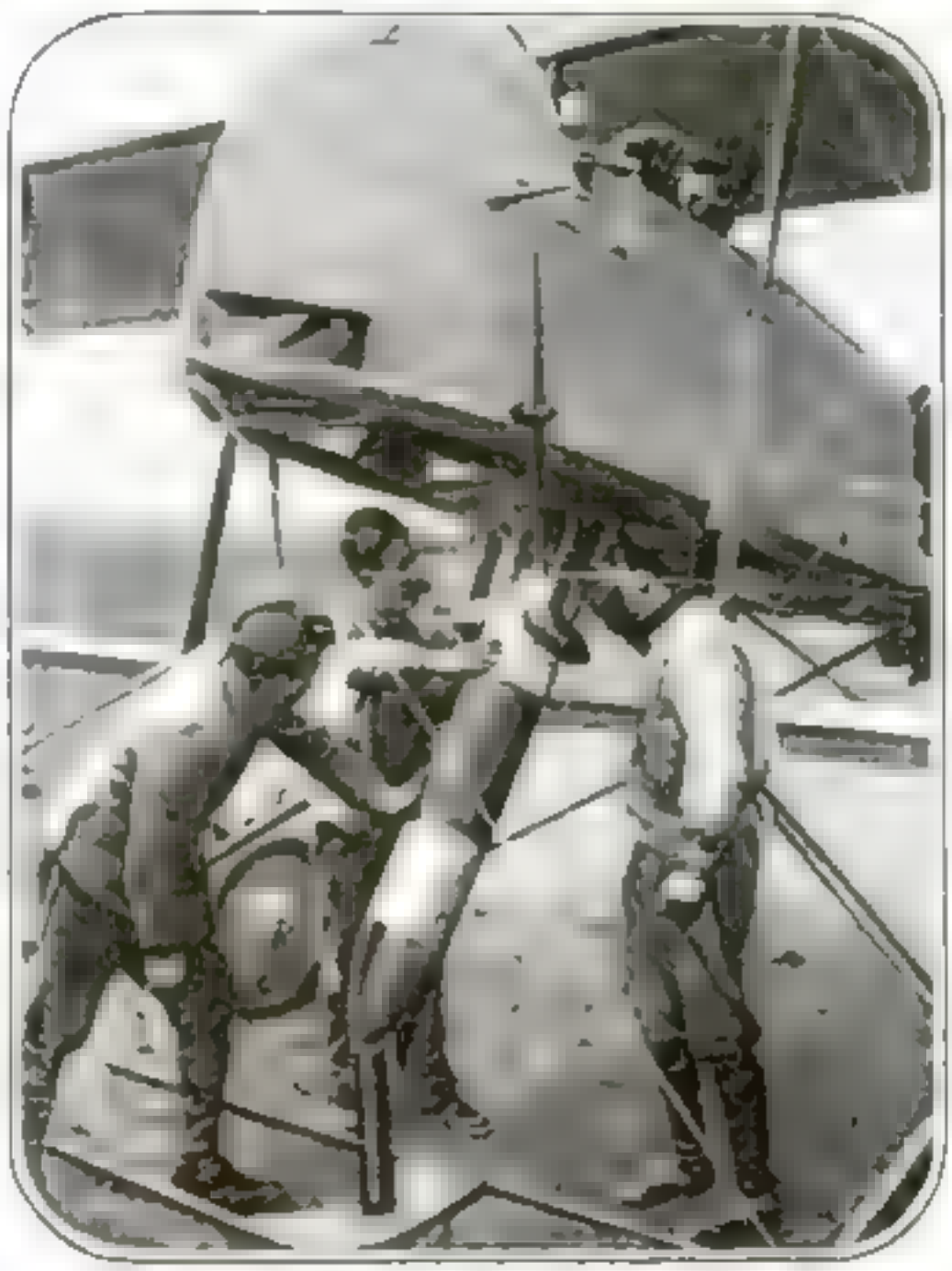
The bombs pictured have been called "aerial torpedoes." They do bear an outward resemblance to the naval torpedo. For all that, the designation is incorrect. The internal construction bears little resemblance to that of a naval torpedo. The bomb shown is provided

A wonderful photograph taken from a French airplane while bombing a German factory in Lorraine. Seven bombs may be seen in the air, all released together by the same machine

with tail planes to make it fly straight—a tail which has the same effect on the bomb as the tail feathers have on an arrow. In addition there is a "propeller" to sensitize the percussion fuse during the bomb's fall.

Particular attention is directed to the extraordinary photograph which shows seven bombs flying through the air after having been released nearly simultaneously. They do not drop. They literally rush through the air like naval torpedoes, thereby to a certain extent justifying their alias. Released from a machine which is traveling at a speed of ninety miles an hour, they necessarily have, for a time, the forward motion of that machine and actually travel horizontally. Realizing all this, their designers gave them an ideal streamline form. In the picture only the lowest bombs have begun to turn downward

visibly and to drop vertically. The uppermost one is seen gliding like an airplane itself in spite of its great weight, in spite of its comparatively small surface and in spite of the fact that it has only a belly in place of wings. The moment bombs drop from their tubes (one-third as slowly as they are swept ahead by the plane) they are swung by momentum and air pressure on their tail planes into a nearly horizontal position. In that position their shape encounters practically no resistance from ahead but a great resistance in the direction of gravity, not only because in trying to fall they must cleave the air with their big broad sides, but chiefly because in dropping they are now opposed by the inertia of the air encountered in falling, and, in addition, the much greater amount of air encountered in moving ahead. As long as momentum continues, falling is greatly retarded, and, with practically no head resistance, it is bound to continue indefinitely. But as soon as actual falling begins, the head dips a little, aided by the tail planes. In this position the fall itself will preserve and increase the horizontal speed, just as in coasting down hill in a sleigh. If the total surface of a correctly designed bomb were not so extremely small in proportion to its weight, it would seemingly never reach the ground.



Slipping a bomb into an airplane. The tail is being inserted smoothly into the discharge tube

Balloonists sometimes threw empty bottles from their baskets. They marvelled at the crazy antics performed by the bottles and the long time they took in reaching the ground. It was the approximation of streamline form that delayed the bottles.

Bombing is like torpedoing. Bombs have assumed the shape of torpedoes not to prolong their fall, a thing in itself rather unfavorable, but because the lower winds have practically no influence over a torpedo. Guided by its tail, the torpedo-shaped bomb simply turns its sharp nose against the wind and cleaves it without deflection.

That is why bomb-dropping is more accurate than it was at the outbreak of the war. Moreover, bombs are dropped on the shotgun or blunderbuss principle. In other words, they are released a half a dozen or more at a time. One at least will find its mark. By releasing bombs in quick succession, errors in judging altitude and speed are readily corrected, because the bombs scatter principally along a line parallel with the path of the machine.

Are You Afraid to Look at Yourself in a Mirror?

Dr. Martiri has recently found that certain patients are afraid of mirrors, —a result of watching the change in appearance as emaciation progresses. When a dyspeptic is cured his horror of looking in a mirror persists. This is called cattotrophobia.

A Bazooka Is a Musical Wimwam

THINGS are not what they seem. This observation of Longfellow's is borne out by the mysterious looking instrument in the hands of the soldier boy in our picture. It may look to you like a cross between a plumber's sign and an opium pipe or almost anything else, but it isn't. You will learn the truth the next time you visit a cantonment. You will learn that this queer-looking object is a musical instrument christened the "Bazooka." How does it sound? Just as it looks. If you know anything about plumbing or steam-fitting you will at least admire the bazooka as a good piece of pipe-fitting. The rookies are exceedingly proud of this weird noise-producer.

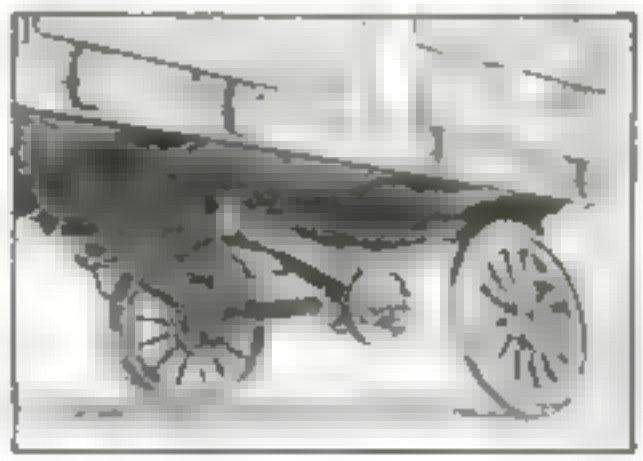
Yankee Doodle came to town playing the Bazooka

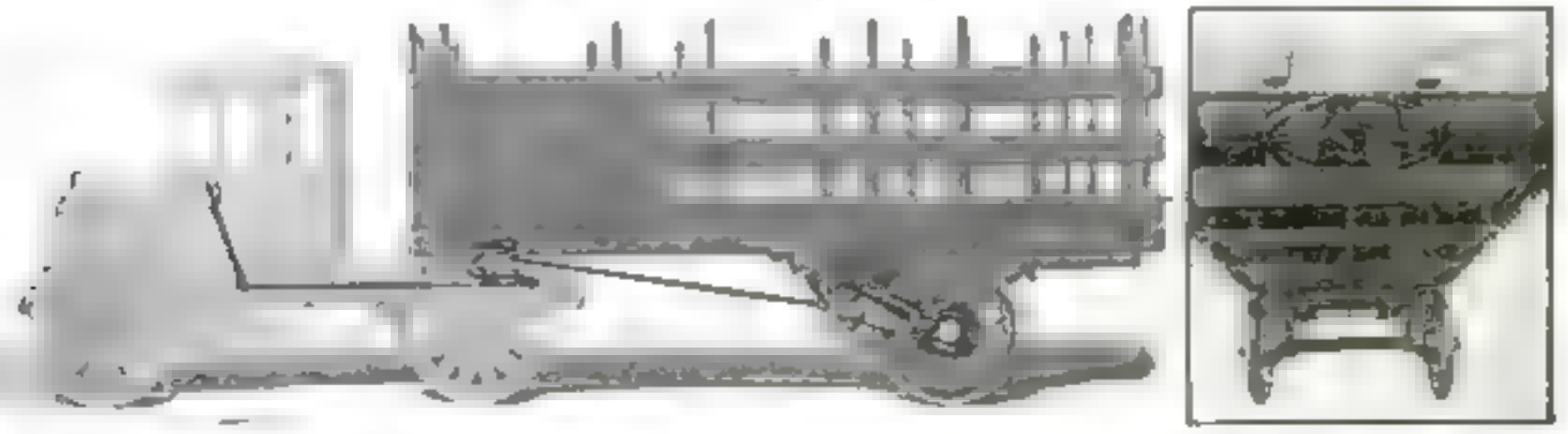
Even in Turning a Corner the Brakes on the Rear Wheel Take Hold

IF you have miraculously escaped injury in a skidding automobile on a slippery pavement, you can readily understand why the rear wheels of a motor truck semi-trailer should have been provided long ago with some form of brakes controlled from the driver's seat. In fact it is quite as necessary to have brakes on the rear wheels of a semi-trailer as on an automobile, for the reason that the greatest portion of the trailer load is generally carried on the rear wheels. This causes them to swerve around very easily when the brakes are applied to the driving wheels of the tractor.

One of the greatest difficulties in the development of such brakes has been the weaving and twisting strains set up between the tractor and the trailer and the necessity of making the brakes hold when the trailer swings around at an angle to the tractor centerline as in turning corners.

This difficulty has been overcome in the new type of brakes, shown in the accompanying illustrations, by mounting the front end of the brake rod in a universal joint at the center of the fifth-wheel, which supports the front end of the trailer body on the tractor platform. As a result, the brakes, which are of the conventional motor-truck type, are always operative, whether the trailer is moving up and down, as when running over rough roads, or when turned, as in rounding corners. The brakes are set and released by an ordinary brake-handle operated from the driver's cab.





The illustration shows regular motor-truck brakes applied to a semi-trailer and operated through a universal joint so that they may be used on corners and turns

Simple Inventions to Make Housekeeping Easy

Curbs, stairs and other obstructions that usually jolt the baby badly are all smoothed out by this new glide cart

Bath spray hose hooked on nail and new hanger that prevents it

A cabinet dumb waiter that rises with the pressure of the foot on the floor

A stout wire clip to prevent a key turning in the lock of a door

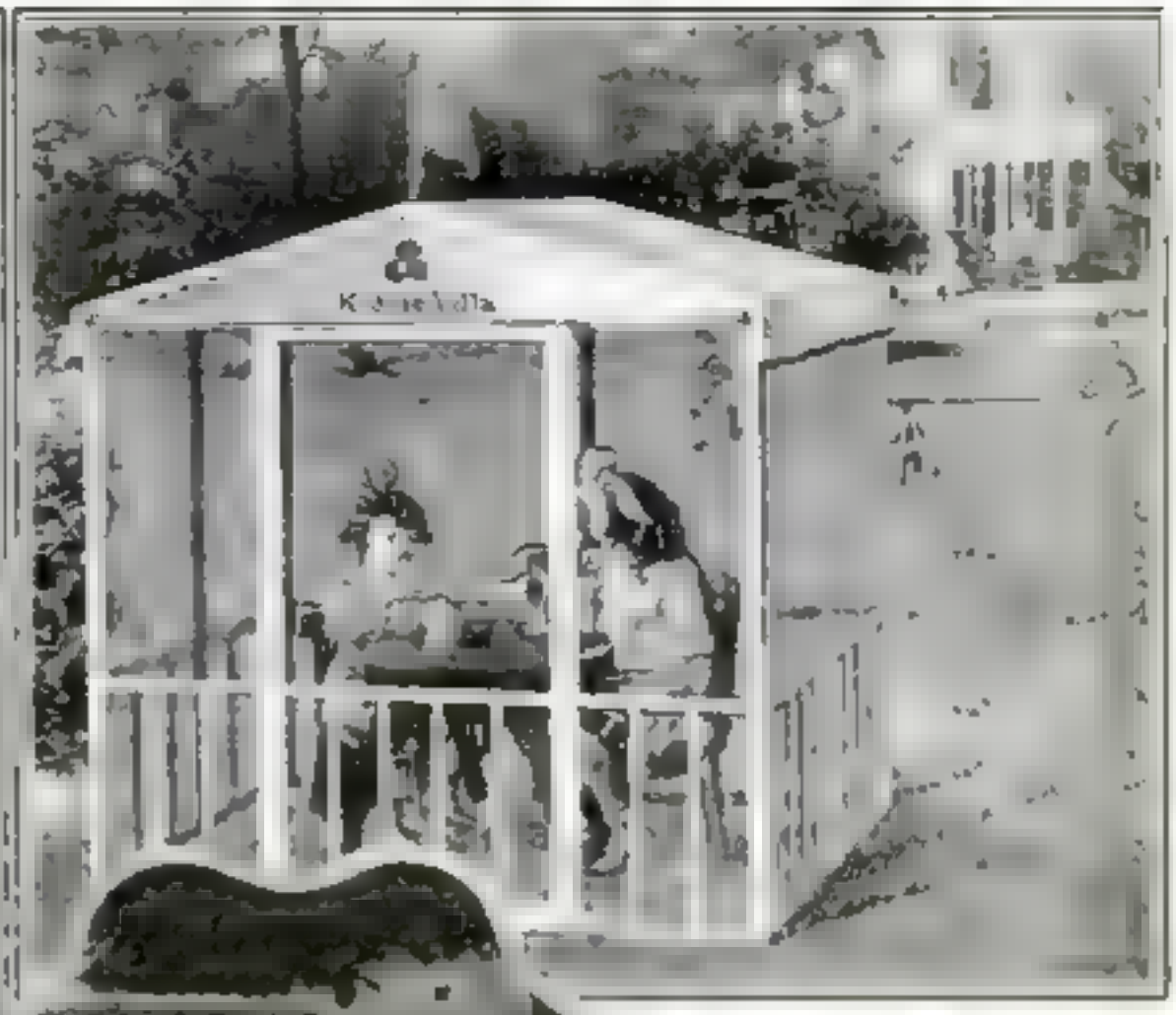
An extension clothes prop that holds the line at any height that may be desired

A handsome tea bail set made either singly, in pairs, or sets of four or six

A gas tip frame to hold a square cup over a gas jet for heating

A convenient tea outfit in a small case for the traveler

A sanitary stone churn mounted on a wood base. The churn is easily cleaned and has great lasting qualities



A canvas covered playhouse for the children with screen netting side walls

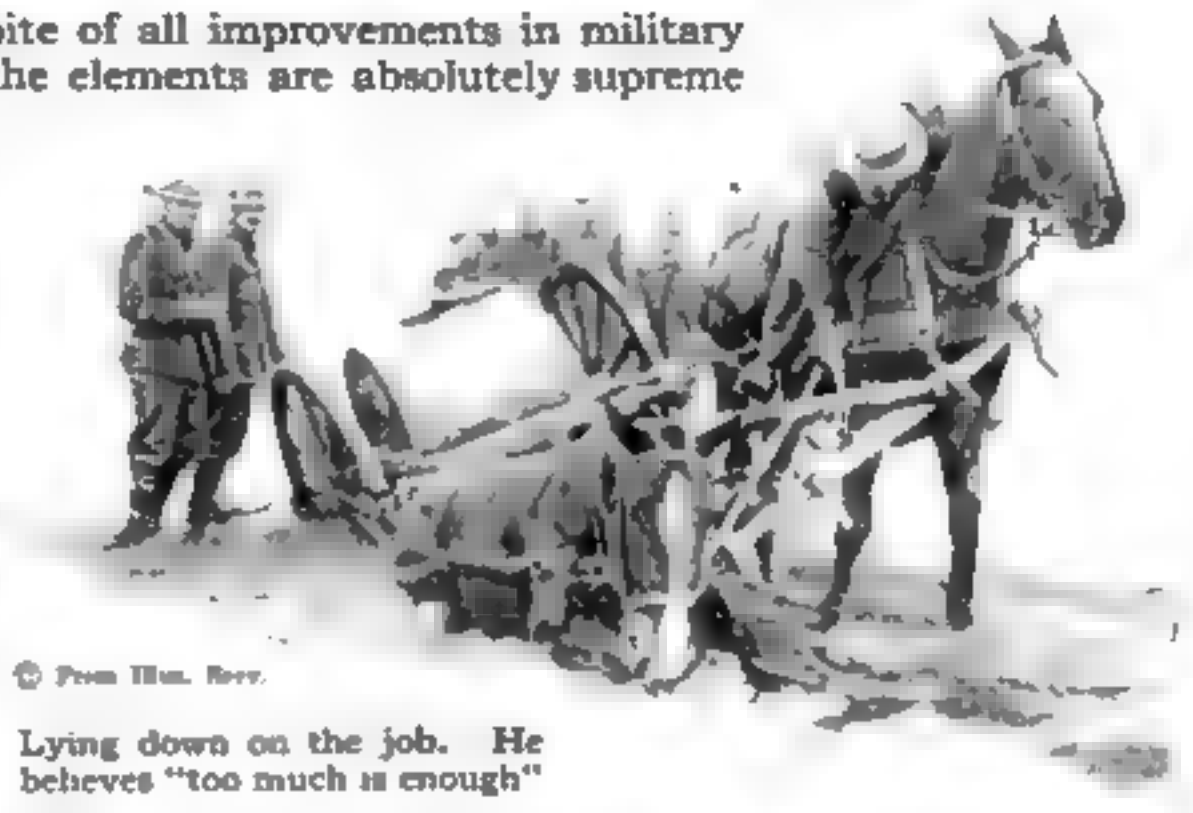
Parts of a knock down chair, showing how it is put together upon arrival at purchaser's

A slip-on table top cover which is used by movers to prevent scratching a finely finished surface in the handling. Strings are run through a hem at the edge which draws the edges together when it is in place on the top

An extra opening in the tea kettle top to pour water into, preventing the scalding of a hand

King Weather Rules the War

In spite of all improvements in military art, the elements are absolutely supreme



© From Illus. Serv.

Lying down on the job. He believes "too much is enough"

LAST October a fleet of thirteen Zeppelins left Germany for an air raid over England. These huge and relatively slow craft are at the mercy of the winds to a much greater degree than the small, swift airplanes, and their sailings are nearly always timed by the meteorological conditions present and prospective. Germany has able weather forecasters, but they are hampered in their work by the fact that the war has cut off their reports from western Europe and the Atlantic—the regions from which come storms and weather changes. Apparently there was a serious miscalculation in connection with the raid of Oct. 19 20, for when the airships turned homeward they had to face strong northeast winds, while dense fogs below blotted out the landmarks. At least four of them drifted far out of their route and were brought down in France; one, the L-49, intact. A fifth is believed to have foundered in the Mediterranean. The crew of the L-49 suffered severely with the cold, the thermometer falling to 36 degrees below zero when they were at the greatest altitude. One man's hand was so badly frozen that it had to be amputated. So much for weather.

In the air, on land and on sea, the weather is playing a capital rôle in the present world conflict. Always a prominent factor in warfare and often a decisive one, it has assumed greater importance than ever before, on account of the addition of aircraft to the world's armaments; the use of asphyxiating gases, borne by the winds; the effects of extreme heat and cold upon the operation of internal-combustion motors; the relation of rainfall and the freezing of the soil to the construction and maintenance of a vast system of trenches; and, indeed, in a host of ways that entered hardly, if at all, into the calculations of military experts a few short years ago.

"Mud Is the Greatest Enemy of the British Army"

Beginning with its predominant influence upon the crops, and hence upon the food supply of the warring nations, one could fill pages with an enumeration of the effects exercised by the weather upon the progress of the struggle. The newspaper reports from the battle zones abound with such episodes as the hampering of operations by heavy rain, the obstacles or advantages offered by fog, the miseries inflicted upon troops by heat and cold, the freezing and thawing of rivers and marshes, the ice blockades of northern harbors, the obstruction of mountain roads with snow, and the atmospheric vicissitudes experienced by aviators.

Veterans of the American Civil War, who thought they knew something about mud, must now take lessons on the subject from the men who are fighting in western Europe. "Mud," says Lieut. G. B. Mackie, "is the greatest enemy the British army has had to face in France, and the only one it feared." The mud of northern France and Flanders will spatter the pages of every history of the war. In the vivid world pictures of Henri Barbusse, mud is the thing that makes the most durable impression. Nobody who has read "Le Feu" can ever forget one

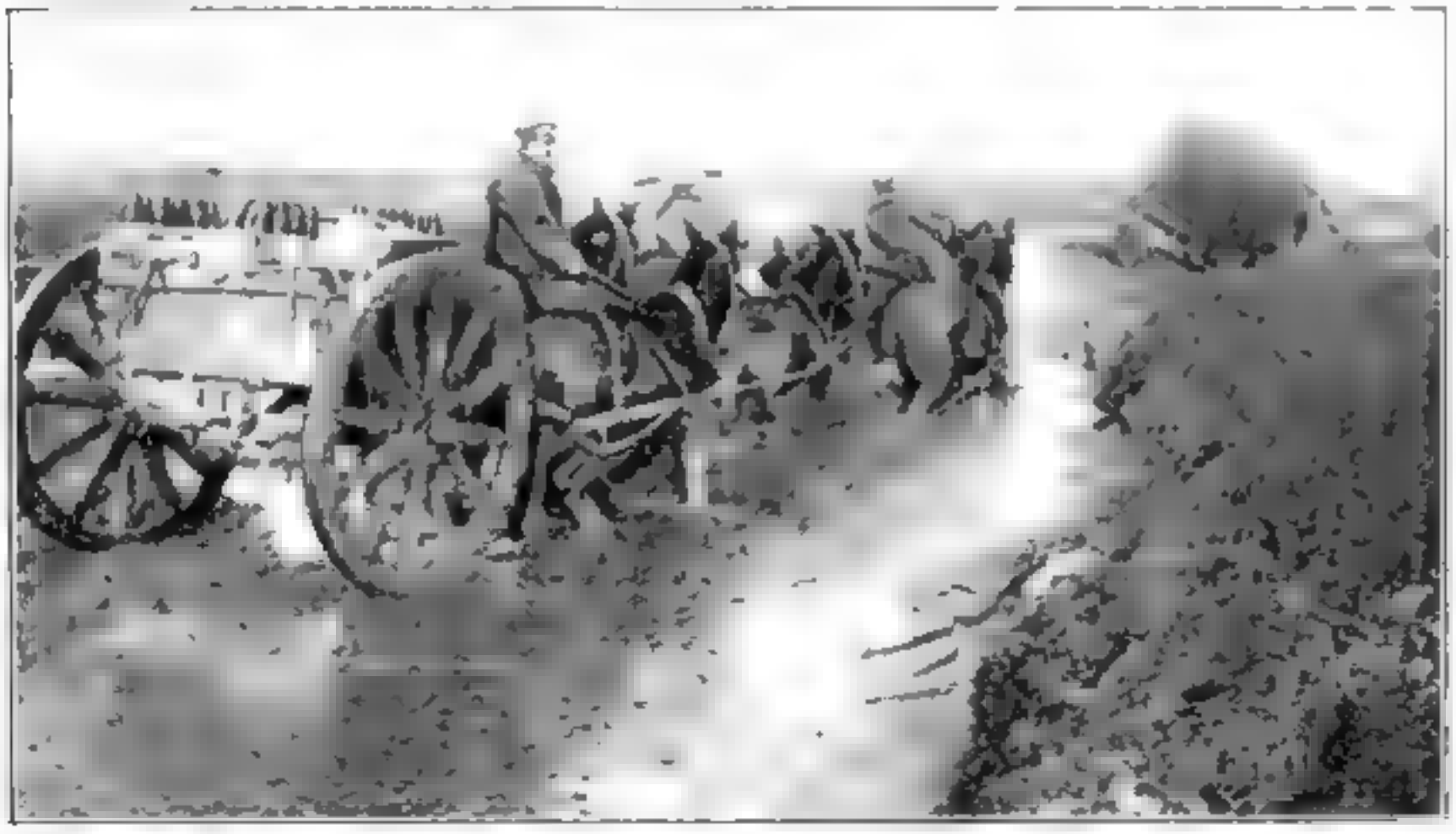
night of drenching misery and the following dawn, when the place where the trenches had been was turned into a sea of mud, with the sentries mired, engulfed and drowned at their posts.

History is repeating itself, but on a vastly enlarged scale. General January and General February have fought for Russia against Germany, just as they once fought against Napoleon. Taking into account its effects upon the civil populations, cold weather has caused more suffering and loss of life in the present war than in a dozen previous wars. In the Mesopotamian campaign the British forces suffered terribly with the heat. Marches were made when the thermometer stood at 110 degrees and over. "We cannot carry enough water," wrote an officer of the Royal Field Artillery, "and one's tongue soon swells when the sun is up." The temperature in the hospital tents was reported as 130 degrees. Imagine the joy (?) with which these same soldiers received from home a consignment of "bullet-proof" vests, consisting of several inches thickness of a heavily woven woolly material!

They Licked the Moisture on Water Bags—It Was So Hot

Ignorance of climatic conditions has been responsible for many serious blunders during the war. The failure of the British campaign at the Dardanelles was partly due to the fact that the extreme dryness of the country was not realized and totally inadequate provision was made for water supply. Water had to be transported long distances on mule-back. When the mules carrying the water-bags reached the troops "the men would rush up to them in crowds just to lick the moisture that exuded through the canvas." In the hottest weather of August the soldiers were reduced to a pint of water a day. Eventually an immense reservoir, with distributing pipes, was built in the Anzac region. In the same region during the following winter, troops from northern Australia, who had never before seen a snowstorm, were treated to severe blizzards, which caused much suffering and illness, as neither clothing nor shelter were appropriate for such weather.

Similar blunders have occurred in every war. The horrors of Napoleon's retreat from Moscow furnish a monumental example of what results from ignoring climate. In the year 1719, a Swedish army under General Arnfeldt was almost annihilated by cold weather on the mountainous frontier of Norway and Sweden. Heavy rainfall and resulting floods led



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Mud, mud, mud! Rivers of it—seas of it. The horses are up to their middles and a truck lies mired up ahead. Yet shells reach guns and the Allied advance is as relentless as Fate

to the total destruction of three Roman legions, under Varus, in A.D. 9.

A Frozen Fleet Captured by Cavalry

Weather and climate are so important in warfare that a commander should always be prepared to guard against their adverse influences and to take advantage of those that are favorable. The mere effect of the weather upon the spirits of the troops may be a factor of success or failure. The character of an extensive "terrain" is sometimes completely changed in a few hours by the weather. Thus, impassable lakes and swamps may be turned into firm ice overnight—or *vice versa*. One of the most picturesque episodes in military history was the capture of a fleet of Dutch men-of-war by French cavalry in the year 1795. The vessels were frozen into the Zuyder Zee. A force of hussars under Gen. Devoynter, having wrapped their horses' hoofs in tow, crossed the ice and forced the whole fleet to surrender. During the Russo-Japanese war Russians made good use of a temporary tramway constructed over the ice of Lake Baikal.

In view of all these facts it is really amazing that military authorities have been so slow in recognizing the strategic and tactical value of weather science and the art of weather prediction. The present war is the first one in which meteorology has been called upon to play any particularly definite part.

There is an interesting historical connection between weather forecasting and the art of warfare.

In the month of November, 1854, a tremendous gale shattered the camp of the Allied armies fighting against Russia in the Crimea, and sank the French warship *Henri IV*, lying off Sebastopol. The famous French astronomer Le Verrier made a careful study of this storm. By collecting the weather records kept in various parts of Europe he was able to trace its course—to show how it had swept in from the Atlantic and moved at a deliberate pace across the continent. He reached the conclusion that, by means of telegraphic reports, it would have been an easy matter to keep tab on the storm's progress and to give timely warning of its approach to the fleet and the army. This was the germ of the idea now embodied in the telegraphic weather services maintained by all civilized countries. Le Verrier submitted his plans to Napoleon III., and they were soon put in operation. Hence the Crimean storm of 1854 is a landmark in the history of practical meteorology, and weather forecasting received its first great impetus from the exigencies of war.

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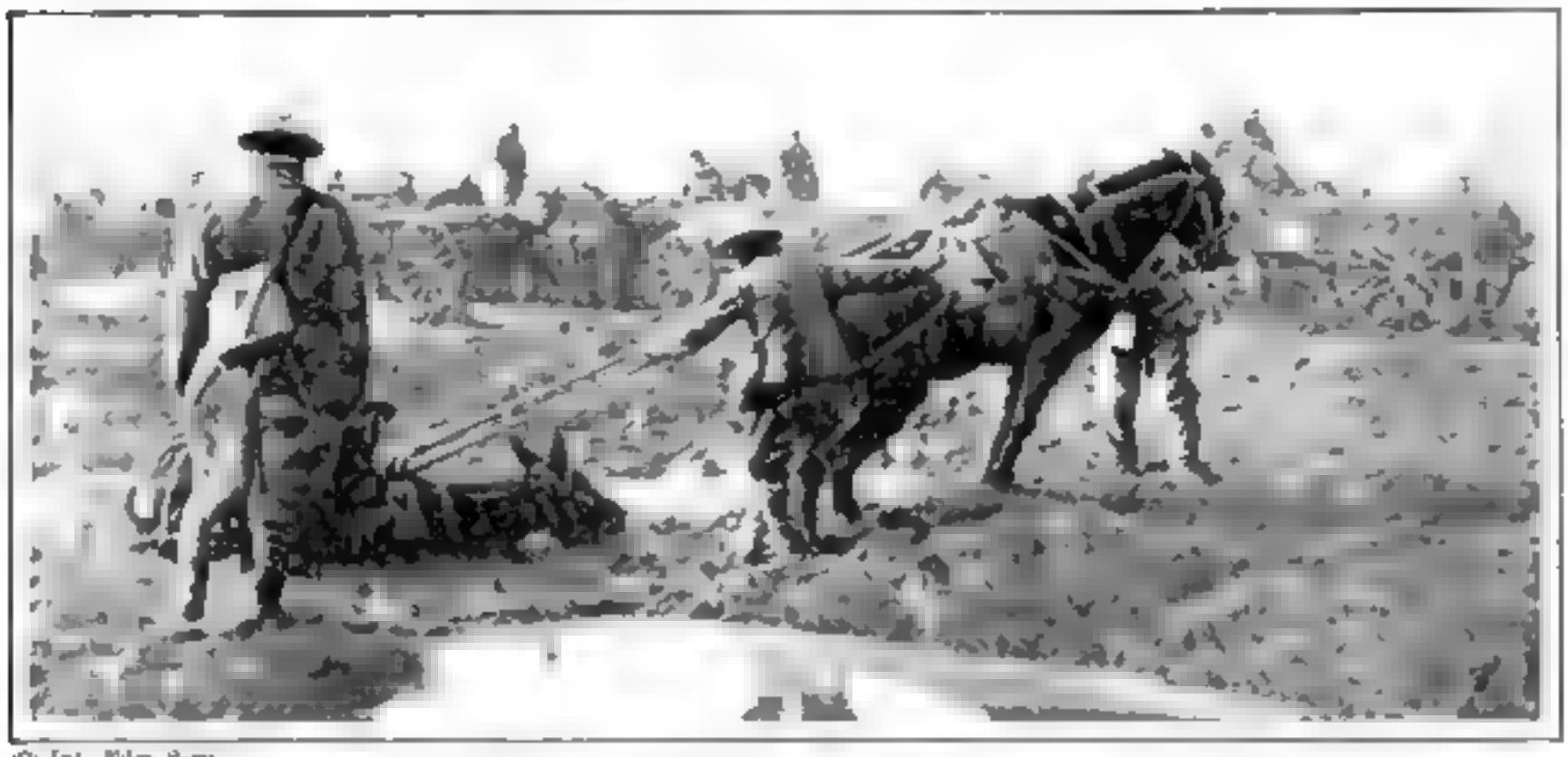
Sometimes it is snow. Still more trouble. This railroad picture was taken on the West-Galician front

Making a Soldier of the Weather Man

To-day meteorologists are paying their debt to Mars. At the very beginning of the present struggle the German army put into the field a well organized weather service. Practiced forecasters were attached to headquarters; posts for making weather observations were established on automobiles; kites and balloons were sent up to test the air currents for the information of aviators and the artillery. In Belgium the Germans promptly took possession of the Royal Observatory, near Brussels, and made it a center for their meteorological organization. Before the war a German observatory had been established in far-away Spitzbergen, at the suggestion of Count Zeppelin, and



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In one awful hole! He didn't see it at all. He just put his foot down and squish!—he walked on nothing. It is quite impossible to tell when the ground will give way and a horse vanish

the reports from this institution proved extremely valuable to the Kaiser's forecasters, until the British government discovered the fact and sent a man-of-war to put this Arctic outpost out of business.

It is humiliating to confess that the *Entente* countries were much slower in mobilizing their weather men, but they are now making up for lost time, and all of them have efficient military meteorological services, supplementing the weather bureaus of peace times. In the British Army there are meteorological units attached to the Royal Engineers. The Italians have established a dense network of weather stations along their battle front. Our own army has a strong meteorological section, under the Signal Corps, officered by experts of the United States Weather Bureau.

For such undertakings there is only one precedent, and it is pleasant to record that the United States Government was the pioneer. During the Spanish-American War our Weather Bureau established a chain of observation stations around the Caribbean Sea, cabled reports from which were the means of protecting the American fleet from unpleasant surprises in the shape of West India hurricanes.

However, all the weather forecasters in the world will not be able to nullify the consequences of cutting the Belgian dykes, and so there will probably be mud, and mud, and mud, to the end of the war—and, likely enough, after that! So let the final word of this muddy article be—MUD!

A Salesman Who Talks to Himself Instead of to You

"YOUR money back, ladies, if this furniture polish is not exactly as I claim it to be.

"That's what I said—your money cheerfully refunded if you fail to find this polish the greatest labor-saving—"

"Look here, mister—you sold me a bottle of that polish last week and I am not at all pleased with it."

"Did you purchase your bottle from me, madam?"

"You know you sold it to me—why—"

"Oh—yes! I recall it now—How "

Every shopper in the immediate vicinity is by this time attracted to the scene by the controversy.

"Did you follow the directions carefully, lady?"

"I didn't read the directions."

"Well—how can you expect results—"

"Yes. I admit I may have used the polish the wrong way. Do you mind showing me how you—"

"Certainly—to be sure—no trouble at all."

With a few rapid applications of the polish, the demonstrator converts the surface of a badly stained piece of mahogany into a bright, glossy, object.

During the entire performance no one succeeded in locating the sweet-voiced complainant. The fact is both voices came from the demonstrator who is a ventriloquist.

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A captive sausage balloon is provided with auxiliary air-bags which serve to steady the balloon. In the latest form these give the structure the appearance of a huge elephant

Now Appears the Elephant of the Air

The reason for the queer shapes of captive balloons

GUY FAWKES' Day in England is a holiday which remotely resembles our Fourth of July—a day celebrated to mark the thwarting of a conspiracy. It was the custom to send up on Guy Fawkes' Day balloons which were effigies of the conspirators. There were also balloons, sent up at county fairs, shaped like pigs and cows.

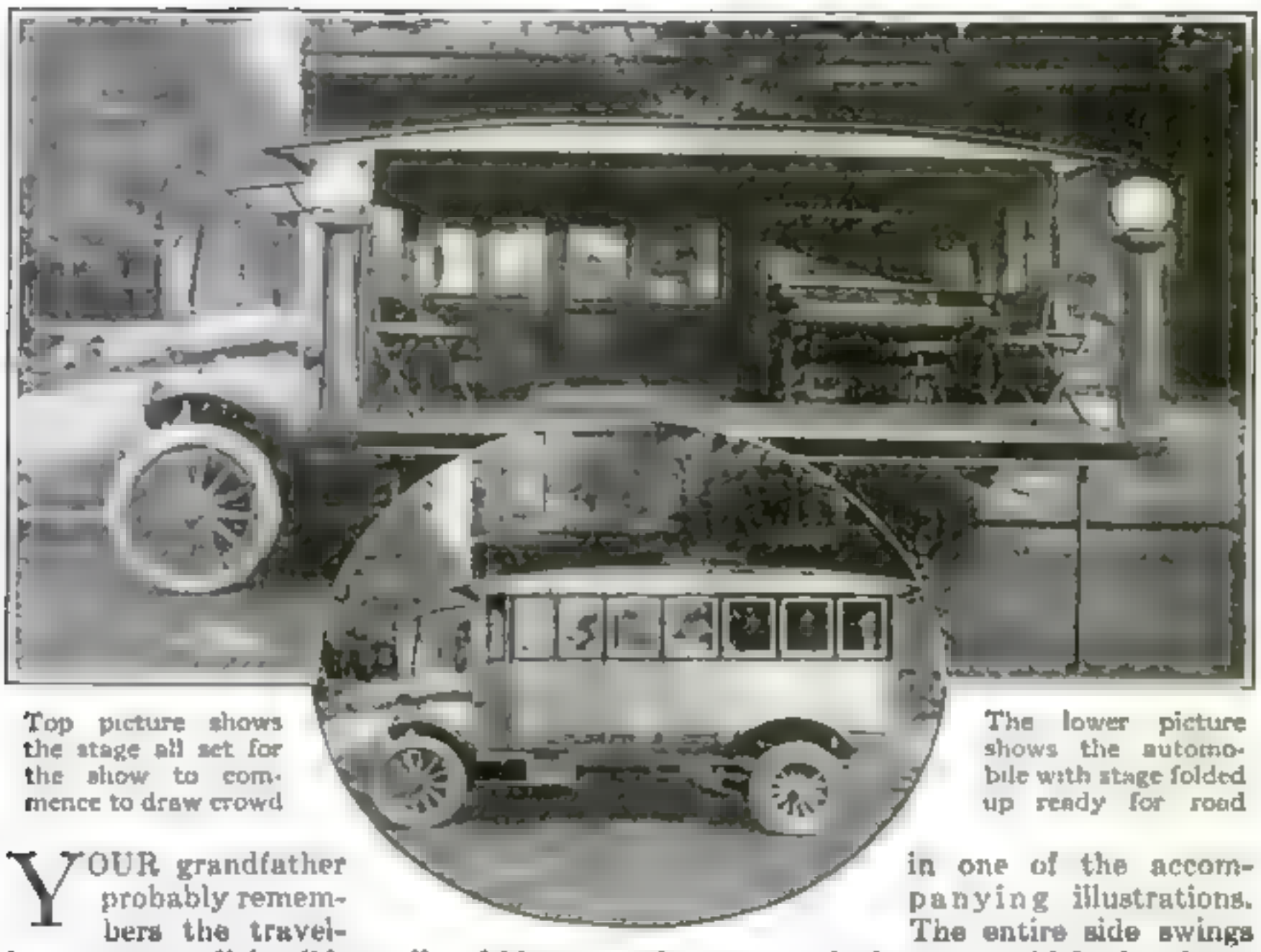
And now comes the French army with its elephant balloon, which is not invented for edification, but an earnest effort to improve the observation balloon.

It was the Germans who invented the "sausage" captive balloon which is raised by the wind after the fashion of a kite. Some countries adopted the sausage balloon and even bought the German manufactured product. Others, like France and Great Britain, obstinately clung to the obsolete spherical balloon. Then came the Great War and prejudice was blown away. The sausage was imitated at once.

A sausage balloon needs various appendages to catch the air and to steady it.

Using Minstrels to Sell Automobiles

This is where the oldtime patent medicine quack is completely outquacked



Top picture shows the stage all set for the show to commence to draw crowd

The lower picture shows the automobile with stage folded up ready for road

YOUR grandfather probably remembers the traveling patent-medicine "doctor" and his concert wagon. The "doctor" and his artists would locate themselves at some strategic point and after a few songs and perhaps a buck-and-wing dance, would draw a crowd of several hundred people to view the free show. A vivid burst of oratory, a glowing picture of what Ox-heart Pills would accomplish, a scramble to buy the precious medicine and the doctor would move on. He combined some of the delights of Coney Island with those of the modern corner drug store.

Although the traveling patent-medicine doctor has almost passed away, his principles have recently been applied by an enterprising automobile dealer in the Middle West to sell a particular high-priced car with a silent type of engine to small dealers in rural towns. He fitted one of the cars he sold with a body in which he stowed a piano as shown in one of the accompanying illustrations. The entire side swings down as a platform on which the singer shrieks *"Over the-e-re, Over the-e-re!"* And now a demonstrator takes the place of the singer. He is not so seductive as he is forceful and convincing. Listen to him:

"Ladies and Gentlemen! You have heard the singer and you have heard the piano. Not a word escaped you. And yet all the while the engine of this car was running. There was no rattling of valve-tappets. There was no roaring exhaust. There was no jingling of loose parts. That's the chief merit of this car—silence. It has an engine which is as noiseless as a cat and as powerful as fifty horses. Step up and get a catalogue."

One hundred and twenty-five cars were sold on one concert tour alone, and others were disposed of later through small-town dealers whose custom was secured as a result of the trip.

Our Annual Coal Drama

Each winter we have a coal shortage. What causes the trouble? Can we cure it?

By Lloyd E. Darling

In the March number Popular Science Monthly discussed the taking over of the railroads by the Government, and the probable effect of the action on the coal situation. This article deals particularly with the coal shortage itself, its causes and effects.—Editor

Actors in Our Annual Coal Drama—Part I.

These are the actors who go across our stage each winter. Many figures you will doubtlessly recognize. Up in the corner the sturdy miner goeth to work. Sometimes he comes back injured. Likewise to the many trainmen and others who have to do with the carrying of the coal to the consumer. They have been especially battered up this winter. These are typified by the lower figure. In the center the coal operator himself. He may be plump and prosperous as shown, or wan and lean, depending on how business goes. Beside him is one of his trusty business getters. And beyond them are our railroads, hamstrung and upset by such devils as congestion, car shortage and freezing weather.

WE'VE had a coal shortage this winter—a severe coal shortage. Railroads have been tied up, people have suffered, legal holidays have been declared, troubles of all kinds have developed. Certainly all our troubles are not due to the war alone. We have had coal shortages before, and no wars to bother us.

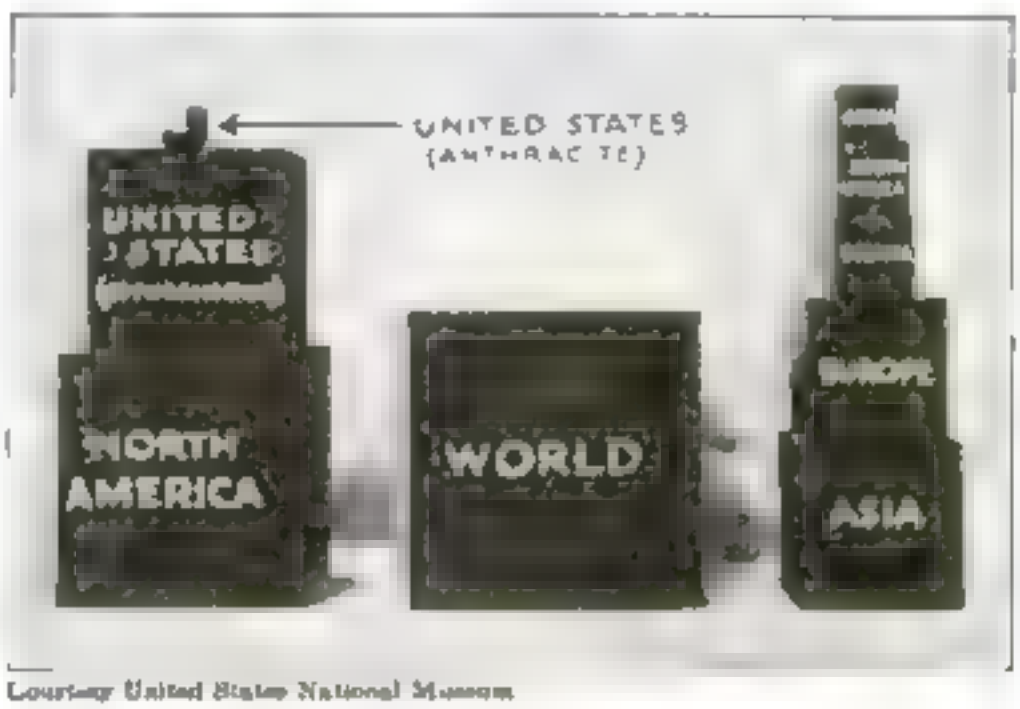
How do we get ourselves into such a predicament every winter? Who or what is to blame? Is there a way out?

On the opposite page we present a diagram recently prepared by Chester C. Gilbert, Curator of Mineral Technology, United States National Museum. It indicates comparative coal supplies of all regions in the world. This diagram demonstrates one point: No matter how many "coal-shortages" we have now, or will have in the future, they are not and cannot be due to a lack of coal in the ground.

Geologists estimate that the Nation has between four and five trillion tons of coal within its boundaries yet unmined. What then is the reason it is so hard to get coal into a man's bins? Diamonds have hardly been more "scarce" than has coal.

The map on page 535 is interesting. It shows the hard and the soft-coal areas of this country. If you are a householder, what kind of coal was it you used this winter? Was it hard coal; or Pocahontas, perhaps? If hard coal, look where it had to come from! Way up in eastern Pennsylvania. If Pocahontas, it was

mined in the West Virginia region. If you live in Nebraska, or North Dakota, or still farther away, this map brings home to you the long distance that coal had to come.



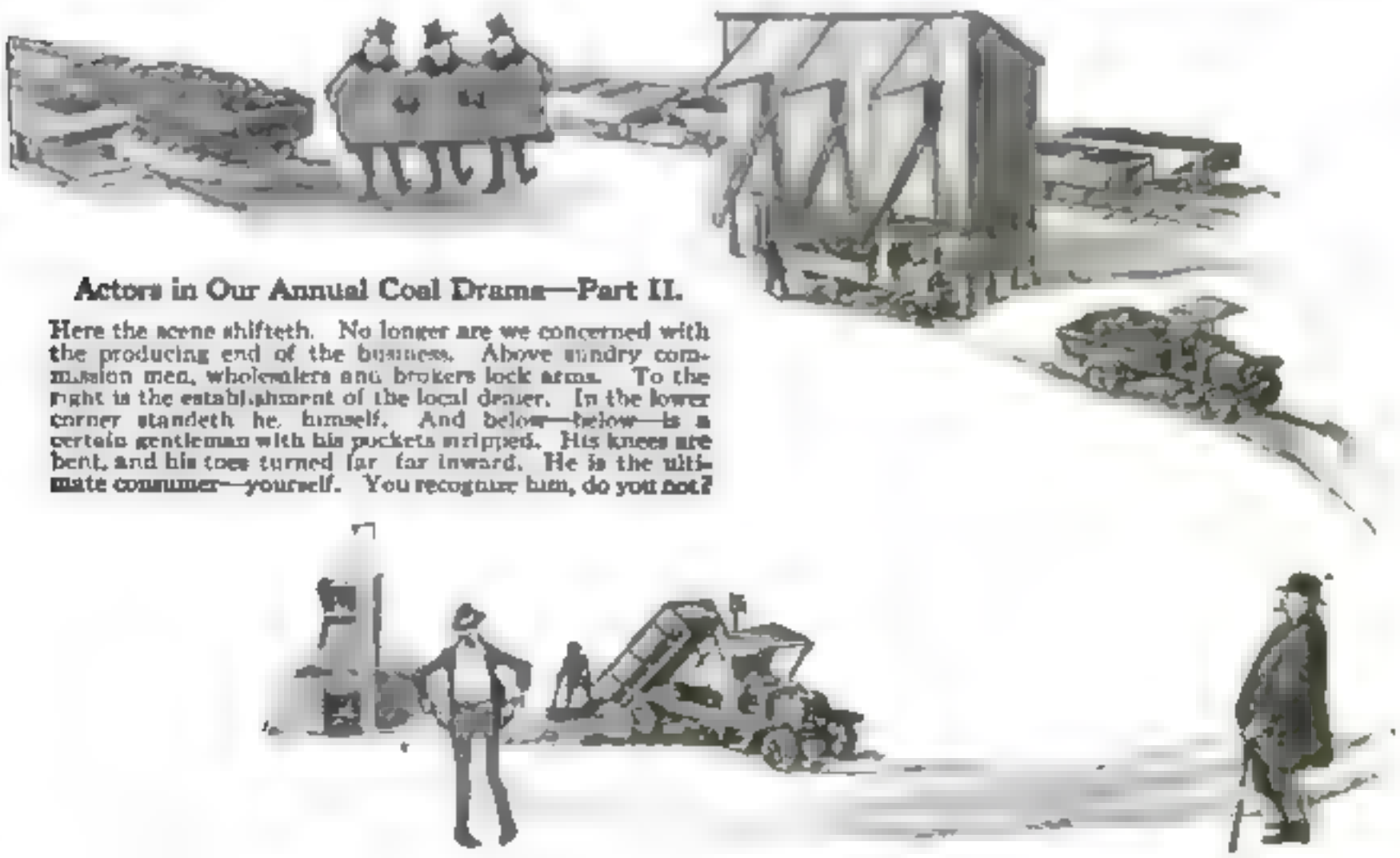
Courtesy United States National Museum

Comparative coal supplies of all regions in the world. Nick in the small cube shows hard coal we've used. Soft coal cube has hardly been scratched yet

If you are a manufacturer, how many hundred miles has your coal traveled this winter? Manufacturers around Chicago demand coal from southern Illinois and from West Virginia. Closer at hand is a plentiful supply. Likewise Iowa will not have Iowa coal, if it can help it. Those in the mountain regions of the West are none too well satisfied with their own supply. In the East, they're such connoisseurs that only the choicest fuel beds are touched. The railroads are cluttered with the crossing and recrossing of coal trains from all these conflicting sources of supply. Smith wants coal from Jones' region; Jones must have it from Smith's. Woe results.

Transportation Causes Trouble

Our annual "coal shortage" is not a coal shortage; it's a transportation difficulty. And bound up with this, are our archaic methods of using coal. To avoid smoke and sooty flues and poor steaming effects, a large share of our boilers and furnaces will take only comparatively good grades of coal. Even then they get only about four or five per cent. or less of the coal's actual energy. To keep these thieves working at all, owners *have* to comb the country for reasonably good coals. It's their extremity that is one big factor in our coal difficulties. Many owners think their present plants efficient. They can well think again. If a



Actors in Our Annual Coal Drama—Part II.

Here the scene shifteth. No longer are we concerned with the producing end of the business. Above sundry commission men, wholesalers and brokers lock arms. To the right is the establishment of the local dealer. In the lower corner standeth he, himself. And below—below—is a certain gentleman with his pockets stripped. His knees are bent, and his toes turned far far inward. He is the ultimate consumer—yourself. You recognize him, do you not?

If Coal Went Over Niagara

Other Waterfalls

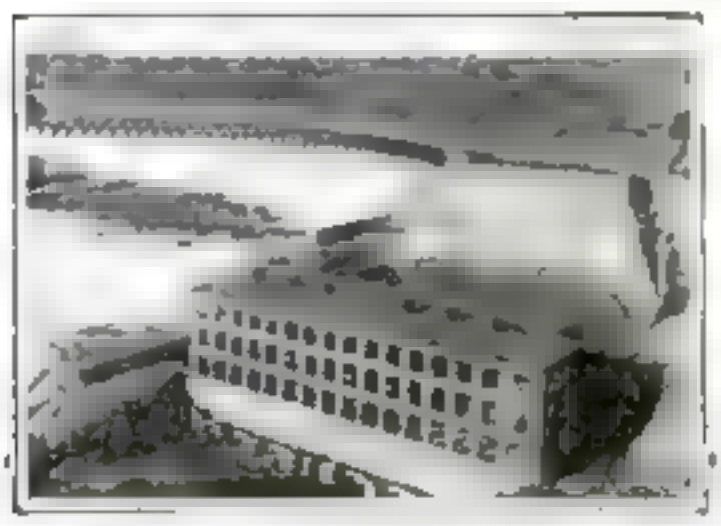
Niagara isn't the only offender in waste power. Many a woodland stream like this over the country is at present wasting itself away. Even its beauty passes unseen

A Mighty Power

While we've been huddled around feebly-responsive radiators this winter, while we have been enduring coal holidays and other makeshift remedies, we've been allowing the equivalent of at least ten tons of coal a second to go over one waterfall. Niagara. How it might look if it actually were coal, is shown above. Oh, Cedrick, if that only went in a man's bins! Farewell coal famine!

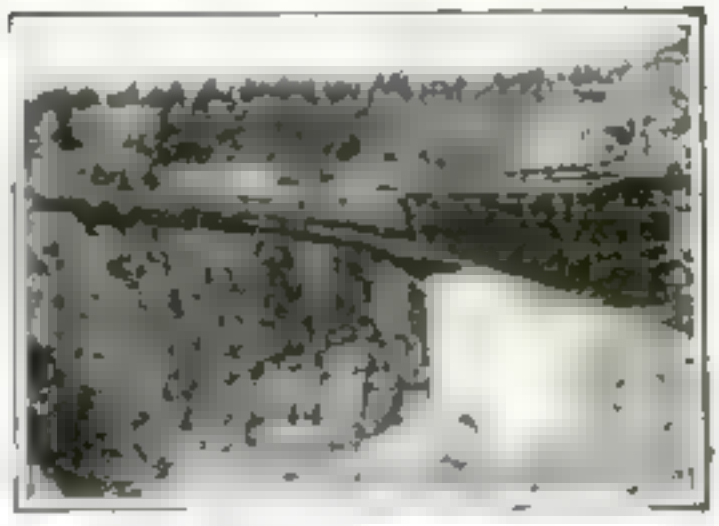
larger share of the plant owners were equipped with the newer apparatus that can burn poorer grades of coal efficiently one large source of coal troubles would disappear at once. Many of the manufacturers could start out with a train of motor trucks some morning, head for a mine in their own county, and get all the coal they wanted, and often not such bad coal at that. The railroads and all their troubles would count for nothing at all. A man would be his own supply and demand. When gas and coke-making plants become more general, these things

What One Railroad Has Done

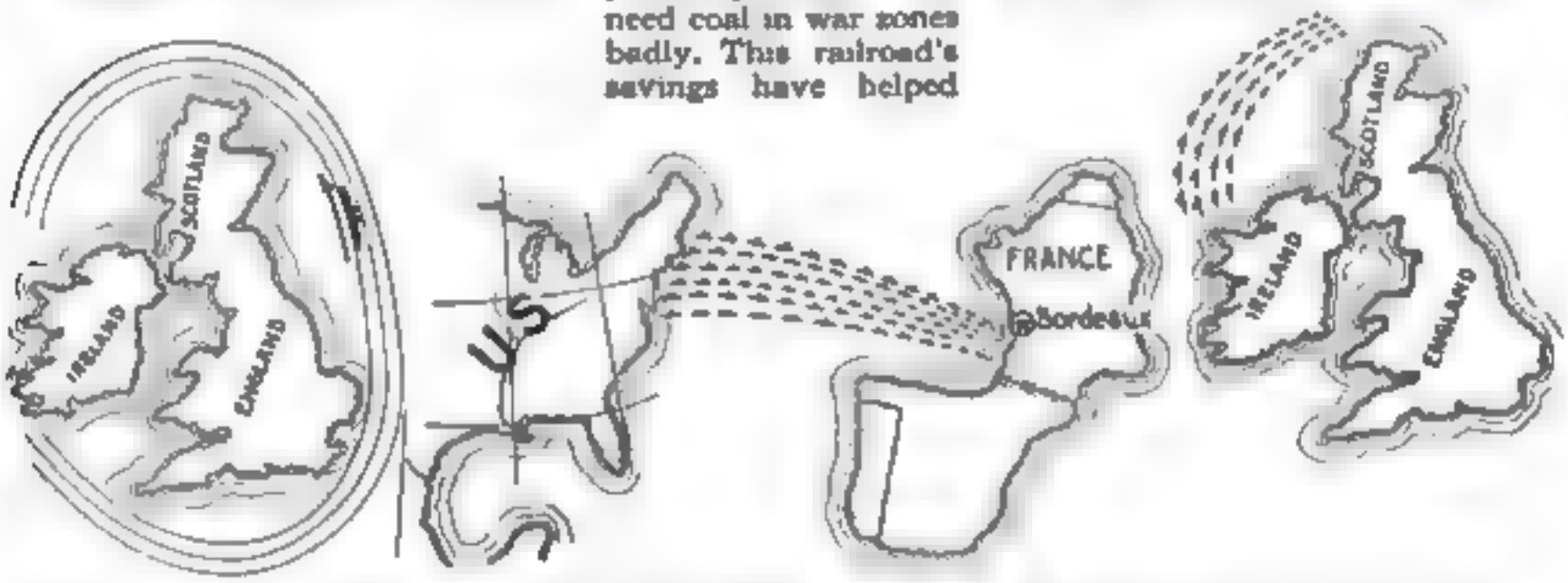


One of the powerhouses far up among the Montana Rockies

By electrically operating but 440 miles of railway, the C. M. & St. P. has effected enormous savings in coal. What it means is shown in the diagrams below



Train driven by the energy of the restless mountain streams



The figures are for one year's operation. We need coal in war zones badly. This railroad's savings have helped

Coal saved would send a destroyer on 2,368 trips around Britain

Or, it would furnish power for sending 90 transports once to France with soldiers

Forty-five destroyers could be kept steaming around the British Isles an entire year

Electrification did away with 126 engines

1,756 tank cars would have had to carry fuel if steam had been used

5,000 coal cars can now serve elsewhere

will come to pass. So also will they when the powdered coal method of burning is more generally utilized. Both systems can do wonders in the way of getting the good out of poor grades of coal.

Inseparably connected with our present railway muddle, and the fact that archaic methods of distributing and using coals make more demands on transportation facilities than any system should, are the peculiar conditions in the producing areas. There are lean years, and there are fat years. There are big operators and there are little operators. Some are located close to trunkline railroads and centers of consumption, others are at the far end of crooked, hill-dodging, weed-strewn branch lines, up which a rusty locomotive and a string of broken-down cars get once a day perhaps, and then again perhaps not. Some of the operators, because of having obtained their

coal lands for little or nothing through some mischance or other, or because they have an especially favorable situation in some respect, generally set the prices for that region. The others, in order to dig in and get business, offer inducements, or endeavor to get the upper hand in some other way. In any case trouble results. Said George Otis Smith and C. E. Lesher, of the United States Geological Survey, in a paper before the American Mining Congress at Chicago some time ago:

"In the many years our coal industry has been developing, rate structures have been built up that give to this and that producing district, differentials (in freight rates, over other districts—handicaps, as it were, that may be based on comparative lengths of haul, difference in coal qualities or mining costs, *or may merely be the survival of past practice, for which no reason now exists.*"

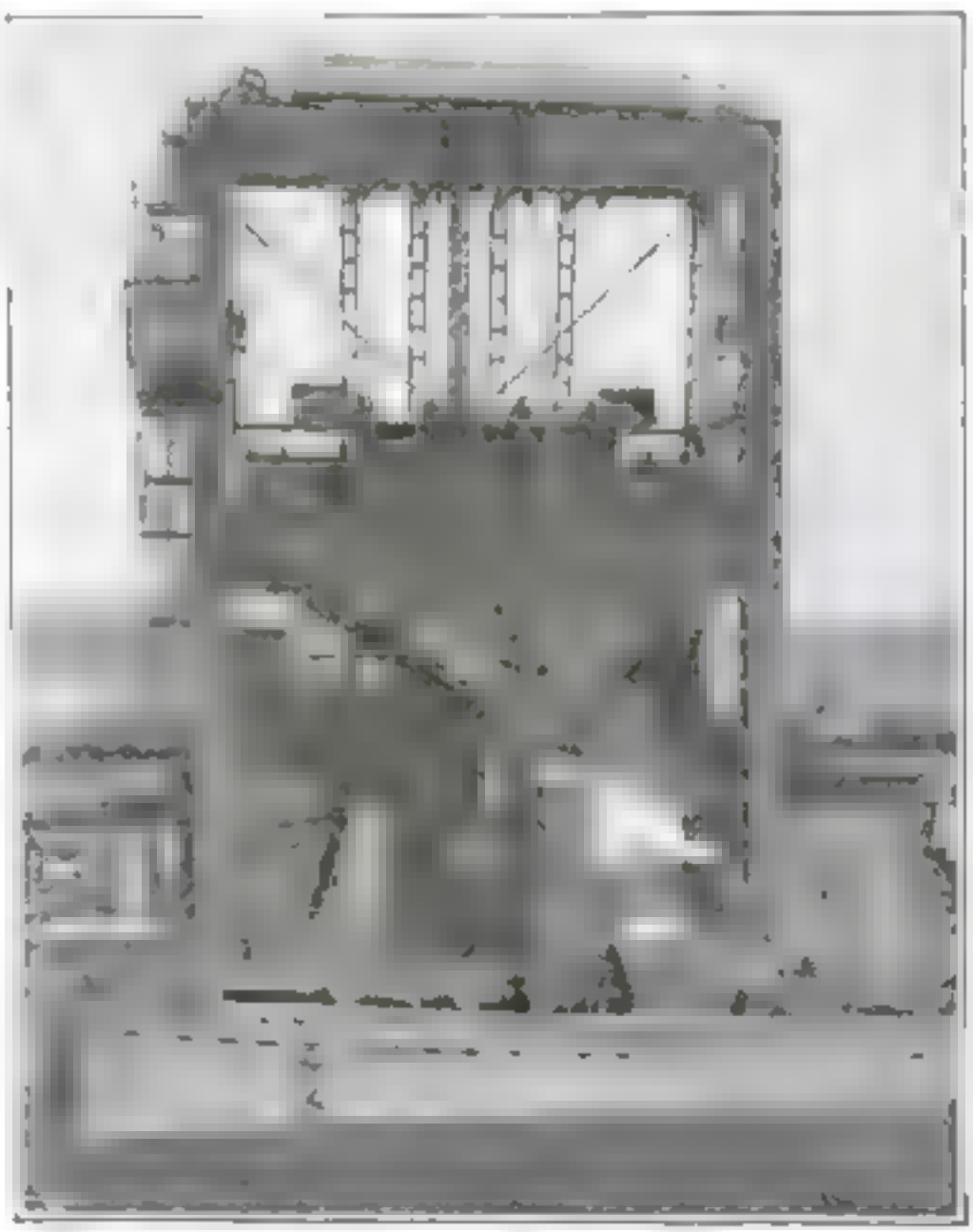
The italics in the quotation are ours. To one endeavoring to analyze existing opinion as to the coal situation in producing regions, that expression would seem capable of summing many of the other factors. Though only about one-tenth of one per cent of our available coal lands are at present being worked, even with that small amount we have allowed an enormous, complicated and erratic producing and distributing system to grow up. What sort of situation we would get ourselves into were we to start in on the other 99.9 per cent of our coal lands is indeed a subject for interested speculation. Coal men have written at length on such a contingency. But certainly the lack of order and system in our coal-producing regions, and in contributing factors that would tend to stabilize producing, must all have a material effect on whether or not we are to continue to have annual "coal shortages."

Prospects for Betterment

Suppose we do have coal shortages every winter, and they are due to these and those reasons, what prospect is there for bettering the situation?

One outstanding remedy for coal shortages is at present commanding the attention of the whole country. This is the development and utilization of our waterpower resources. M. O. Leighton of the Geological Survey estimates that the country has between 36,000,000 and 66,000,000 horsepower at present running idle in rivers and mountain streams. The figure runs as high as 200,000,000 horsepower, if all practicable storage sites are included in the estimate. And the noteworthy aspect of the situation is that waterpowers, once developed, are a permanent source of energy. On the other hand, when we take our coal out of the ground and burn it, it is gone forever. In the interests of our future fuel supplies we should at once start in to make good use of the part that is going to waste at present, to our great loss.

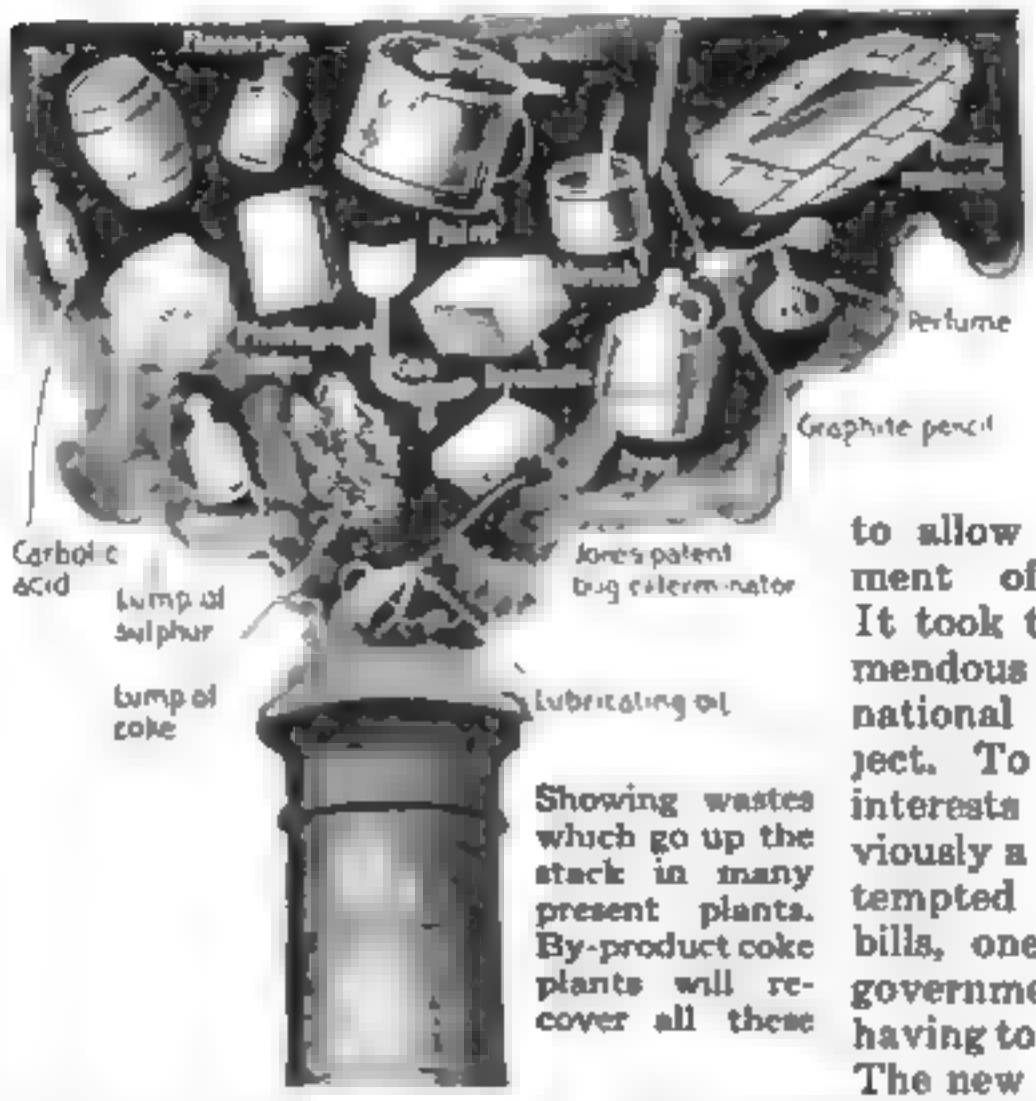
The reason our waterpowers have not been fully developed heretofore is that such restrictive legislation has been passed by Congress that men will not invest their money in plants. Franchises have been revocable by the Secretary of the



© Underwood and Underwood

One of the huge terminal coal-handling plants, hard-pressed this winter. This one is in New Jersey

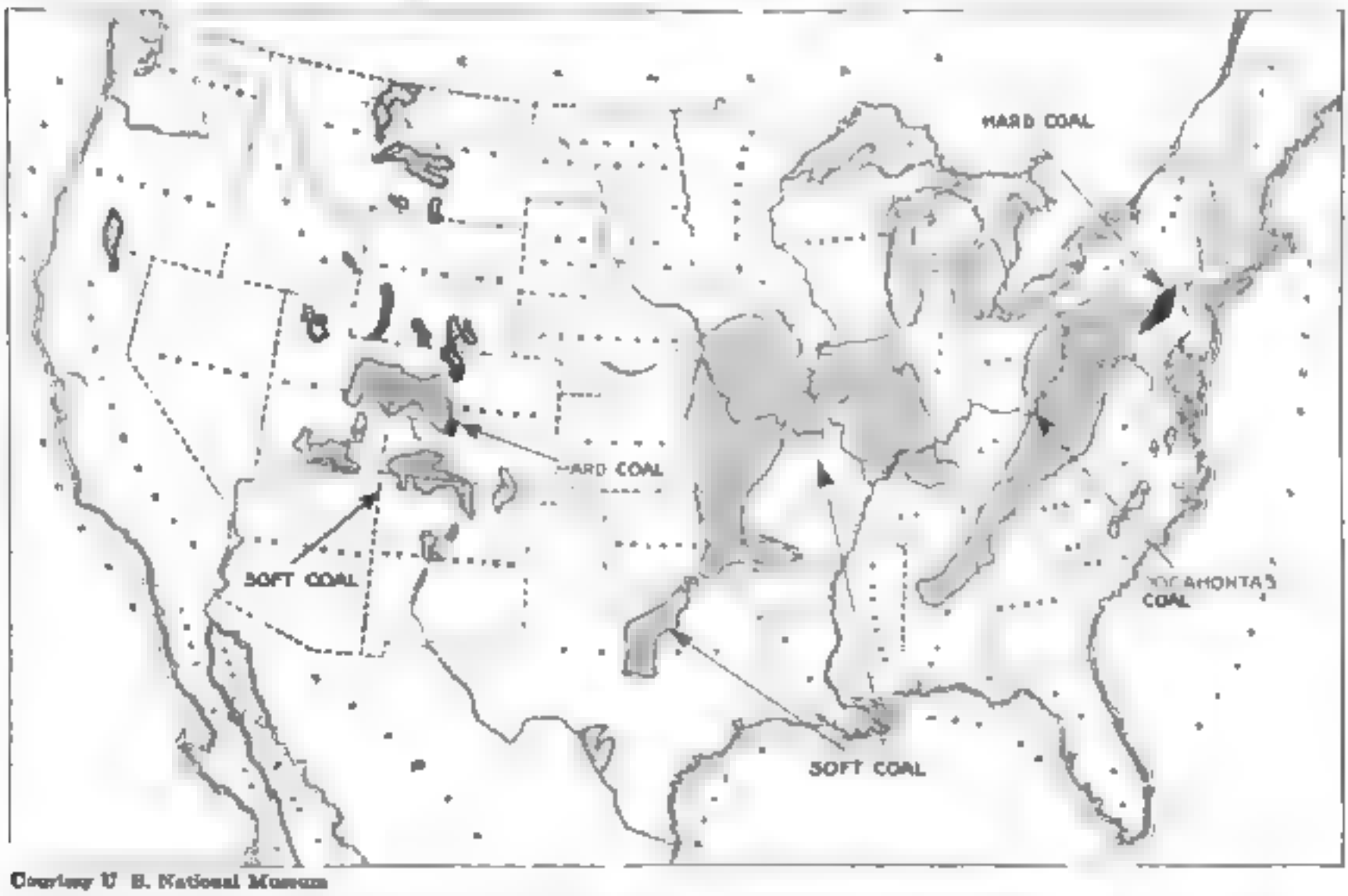
Interior at will. Would you put millions in a water-power plant when at one stroke one man could render the investment valueless by cutting off your right to operate? This restrictive legislation we passed some time ago when many were fearful of the formation of a waterpower trust. While there may have been some danger of it at times, all semblance of such tendency has effectively been dispersed by the thoroughness with which waterpowers are bound up at present. All hands have promised to be good if only Congress will open up the way a little.



Showing wastes which go up the stack in many present plants. By-product coke plants will recover all these

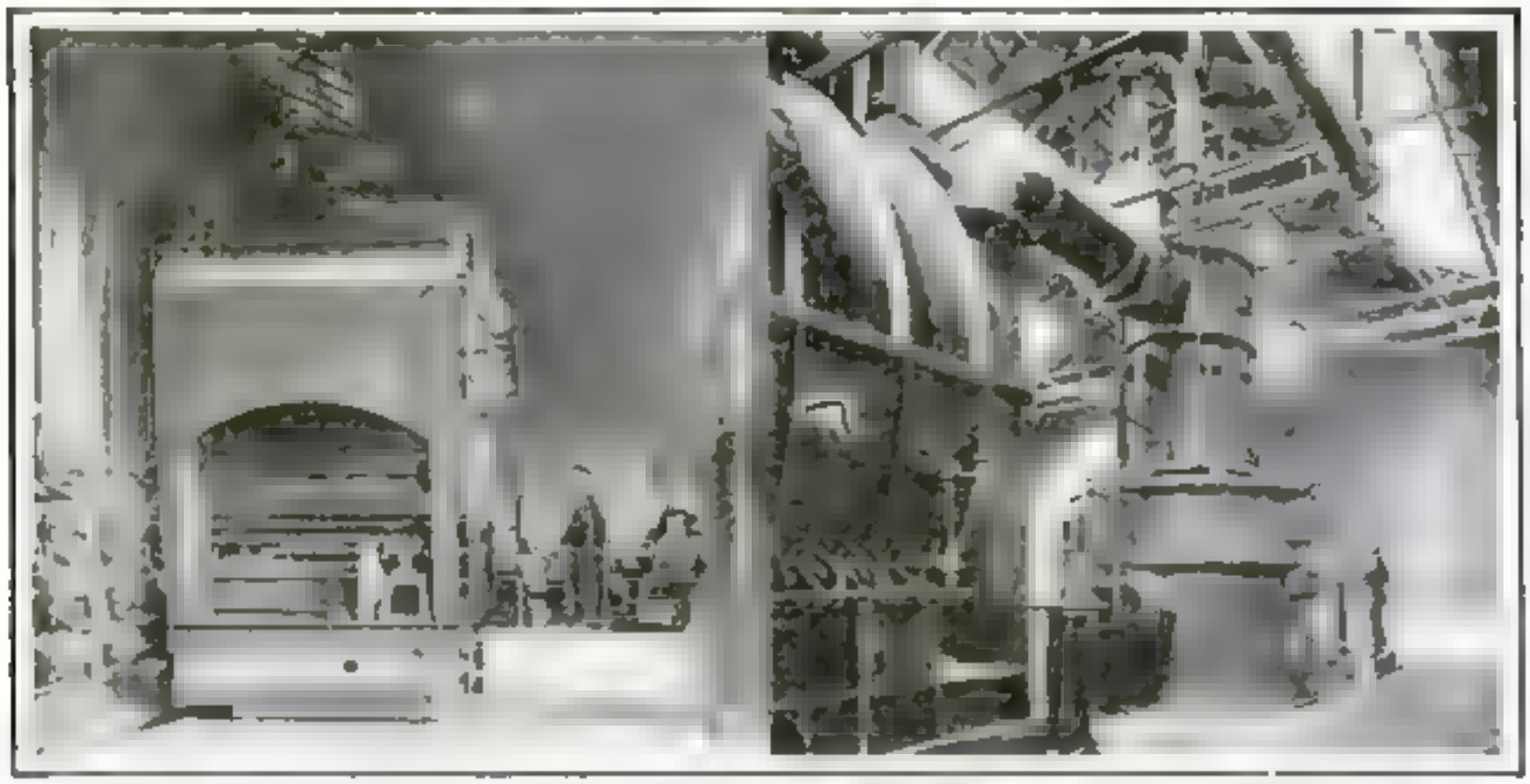
At present there is a bill before Congress sponsored by the Administration and designed to allow the proper development of our waterpowers. It took the pressure of a tremendous coal shortage to focus national interest on the subject. To prepare the bill, all interests collaborated. Previously a solution had been attempted by proposing three bills, one each for the three governmental departments having to do with waterpowers. The new bill has the country's best thought behind it, and if anything will help relieve our "coal shortages" via the development-of-waterpowers route, this evidently should.

A striking instance of what the development of waterpower can do in the way



Courtesy U. S. National Museum

The hard and the soft coal areas of this country. Material inroads have been made on our hard coal stores. However, three to five trillion tons of soft coal remain in our lands



At left: Charging coal in a modern gas plant. Right: Tar-separating machinery. Huge plants like these will increase in number, supplanting our present antiquated fuel users

of saving coal is brought out by figures recently compiled by the Chicago, Milwaukee, and St. Paul railway. This line has 440 miles of railroad electrified between Harlowton, Montana, and Avery, Idaho. Hydro-electric powerplants driven by mountain streams furnish the power. In one year's operation startling results have been achieved. These we make clear in the figures on page 533. If all coal saved had had to be hauled up through St. Paul from Illinois and Eastern sources, think what a tremendous additional burden it would have been on the railroads. Similar savings can be effected on all roads. After the war the country will probably make immense strides in this direction.

Says E. W. Rice, Jr., president of the American Institute of Electrical Engineers:

"The waterfalls constitute potential wealth which can only be truly conserved by development and use—millions of horsepower are running to waste every day, which, once harnessed for the benefit of mankind, become a perpetual source of wealth and prosperity

"It is really terrifying to realize that 25 per cent of the enormous amount of coal which we are digging from the earth each year is burned to operate our railroads under such inefficient conditions that the average of 6 lb. of coal is required per horsepower-hour. The same amount of coal burned in a modern central power station would produce equivalent to three times that amount of power in the motors of an electric locomotive, even including all the losses of generation and transmission from the source of power to the locomotive."

Future of Our Coal Situation

From all indications, the trend lies in the direction of the development of our waterpowers, the use of powdered coal, and the establishment of gas and coke plants. These last will take raw coal, convert it into coke, gas, and by-products. All will be efficiently used. This means a great deal for the dyestuffs industry, farming, and all branches. Says William Hamlin Childs, an authority on the by-products industries:

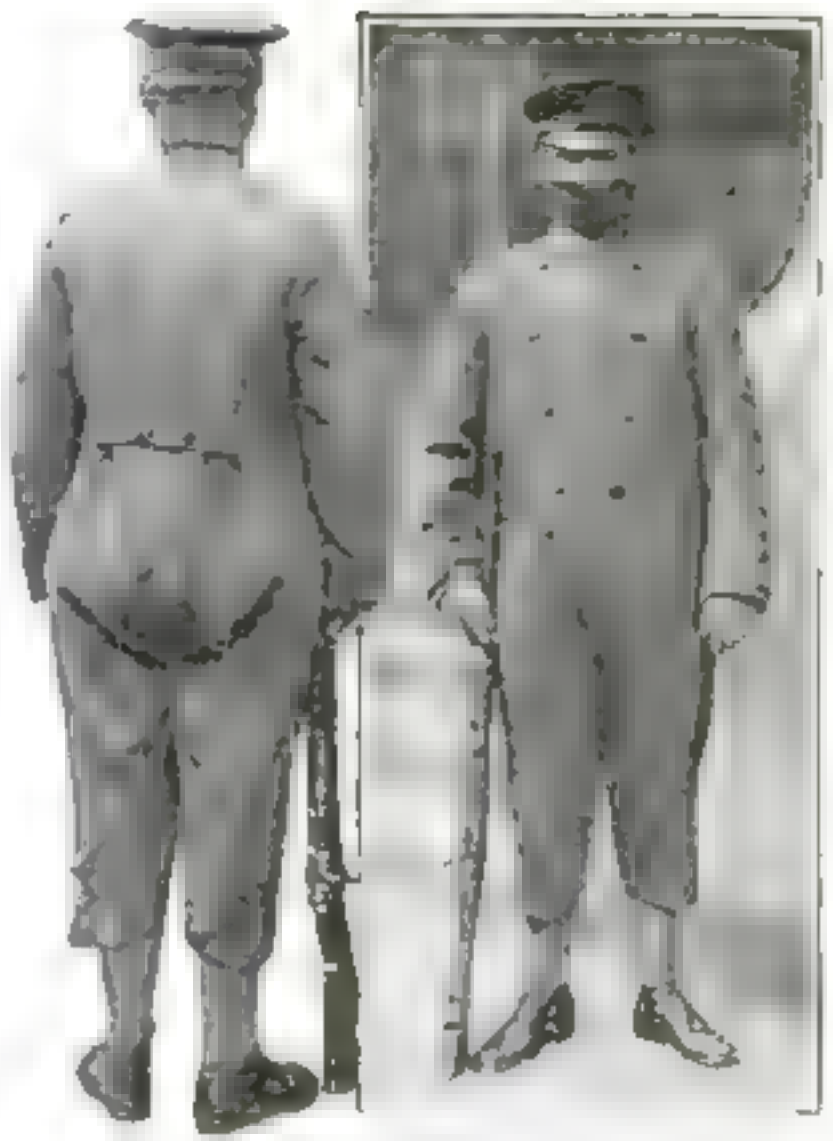
"A four foot vein of coal will yield enough sulphate of ammonia to fertilize the land lying above it for 1,000 years."

This, he means, is in addition to all the coke the coal will yield, and other products. Truly our present-day boilers and furnaces are inefficient in getting the good out of coal. When men get to using our three to five trillion tons of coal in the new way, what won't it do for the country?

It may be worth noting in conclusion that all England is about to make an extensive experiment in fuel conservation. As far as possible all railroads are to be electrified, factories operated from central stations, isolated plants done away with, and other marked changes brought about. Electric powerplants will be located at mines, doing away at a single stroke with railroad transportation problems. London smoke and fogs will be cut down.

If You Don't Smell All Right in a Bee-Hive, You're Kicked Out

ALL bees smell alike to average mortals, but Dr. N. E. McIndoo, whose book, "Recognition Among Insects," has recently been published by the Smithsonian Institution, has trained his nose until he can recognize the three castes of bees—queens, drones and workers—merely by smelling them. He can also distinguish several other odors peculiar to bees and their hives. His experiments show that the bees themselves recognize one another by individual odors, and use the sense of smell for as many purposes as human beings use their eyes and ears. "Worker bees returning to the hives from the field pass the guard unmolested, because they carry the proper sign, although the hive odor they carry is fainter than when they left the hive, and it is also partially masked by the odors from the nectar and pollen carried by these bees."



As you see, this military coat can be converted into a union suit if desired

Turn Your Coat Tails Into Trousers for Free Movement

THE new coat shown in our illustration affords closer protection for the legs, inasmuch as it can be buttoned tightly around them. This arrangement prevents the flapping of the tails of the coat and makes walking or even running much easier. The new model also permits the wearer to crawl without difficulty and thus makes itself valuable in the trench style of warfare. A further use of the new coat is that it can be made to fit comfortably into the high rubber boots worn in the trenches, thus preventing it from slopping in the mud.

When the overcoat is not buttoned about the legs, it presents nothing unusual in appearance, closely resembling, in fact, the ordinary models.

A Noose Used Not for Hanging But for Life-Saving

JUST escaped, perhaps, from danger, the half-dazed fire victim often finds descent all but impossible.

To make this descent safer, Hulda E. Astarita, of Brooklyn, New York, has patented a new device. It is a simple, swinglike seat with a footboard attachment. The parts are held together by ropes, and an extra loop of rope is attached, noose fashion to both sides of the carrier about midway between the seat and the top.

This loop of rope is slipped over the head and allowed to tighten itself about the upper part of the body. Any pressure on the footboard serves to tighten the rope more securely about the body.

This new self holding fire escape is a Brooklyn woman's invention

Browning, the Gun Wizard

Old John Browning has produced the finest machine guns for our army ever invented

By Edward C. Crossman

The Mysterious John M. Browning

Who is Browning? Millions of Americans must have asked themselves that question when General Crozier, Chief of the Bureau of Ordnance testified before an investigating committee that he had decided to equip the United States army with the Browning machine gun. John Browning has been an inventor of firearms all his life. Shotguns, rifles and pistols such as Winchester, Remington, Stevens, and Colt are all of them John Browning's invention

AMERICA has finer guns in the Browning light and heavy type than any nation now at war. While the members of Congressional military committees vapored and fumed that blue print guns never killed an enemy, and that the unknown Browning gun was an experiment and a doubtful experiment, the officers in the Bureau of Ordnance and the great Browning smiled quietly.

We had about thirteen hundred guns when war broke out, which were of a type ordered abandoned in favor of a better one by the powers that be after the tests at Texas City. When war broke out the Germans were known to have fifty thousand machine guns—and the fact is now rather well known that they didn't advertise during 1914 *all* the war-material they had accumulated.

Europe had no light machine gun outside of the French Hotchkiss and Bénet, and they were not entirely satisfactory. When there came over the horizon the light Lewis gun, one of many American machine-gun inventions, the British waxed enthusiastic. The gun worked most of the time, weighed but twenty-six pounds, had a very easily-changed magazine holding forty-seven cartridges, and very successfully coped with the need of a light machine gun that troops could carry forward—or back—in times of need. This did not mean that the Lewis was perfect. It has been known to jam and stop and break parts. Those guns bought by the United States and sent down to the border did not prove impeccable. In fact all the machine guns, so far, have their weak points in one respect or another. Each new one is, however, nearer perfection. So came the Browning. But we will speak of the man himself.

Who Is Browning?

Let us first trace the record of John Browning, a rare notable without a press agent, an inventor of more successful firearms than any man who ever lived, with his identity buried under the names of the great companies making his arms under royalty agreement with him. He is the inventor of nearly all the Winchester models from the 1878 model to the fine 1906 rifle; the man who gave the world the Remington autoloading shotgun and the Remington autoloading rifle; the master who perfected the Stevens 12-gage repeating shotgun; the creator of the United States Army's Colt automatic machine gun; the designer of all Colt automatic pistols, from the largest to the smallest; the patentee of the great Government .45 automatic pistol, now the hand-gun of our troops, and the man from whom Belgium, long before the war, bought the right to make automatic shotguns, rifles, and pistols of different calibers and models.

In 1914 Browning, the square-jawed, retiring, silent American Yankee, in his plain Yankee store-clothes, was made a Chévalier de l'Ordre de Léopold and decorated by the King of Belgium on the occasion of the completion of the millionth Browning automatic pistol by the Fabrique Nationale of Liége—a pistol that ran considerably more than a million in one model and caliber without a change.

John Browning made his first patented gun in 1880. That weapon was the

Winchester single shot rifle. Six hundred of these rifles were made by Browning and one of his brothers in the then little frontier town of Ogden, Utah, in a little shop, from forgings made for them in the East. Then the patent was bought by the Winchester Co., and the fame of the Winchester has since spread over the world.

The older type of Browning machine gun, better known as the Colt, was adopted by this Government in 1890, and has been in use the world over since. The Colt and the Marlin plants turned out this gun by the thousands for the belligerents after the war broke out. No Browning gun has ever been discontinued in manufacture—and the record runs back for nearly forty years.

This is the man, who, a worried Congressional Committee feared, could not turn out a gun as good as the well known types—merely because it had not been taken over to the torn fields of Europe to prove its worth.

A machine gun, as you know, means in these days a rifle firing the cartridge of the infantry rifles of the army using it, and firing such cartridge at a rate of speed of from four hundred to seven hundred shots a minute by virtue of using either the recoil of the breech parts to work the extracting, cocking and reloading mechanism, or else gas taken from a tiny hole up the barrel and working against a piston precisely as gas does in the automobile form of gas engine. It is a gun that works by machinery. The old Gatling was a machine gun, but not an automatic machine gun, because its moving power was a crank in the hands of the firer. All modern machine guns are automatic.

Browning's Three Wonderful New Machine Guns

The first of the recently tested Browning guns, falling in the class of guns to be readily moved about, turned out to be water-cooled and to weigh only twenty-five pounds, which is marvelously light for a gun of this type. It must, however, be fired from a tripod which weighs twenty-five pounds more. The second was a little thing weighing fifteen pounds, the lightest machine gun ever built—more properly an automatic rifle as the modern term is coming to be for the light machine gun. Your father and mine thought nothing of shooting a duck gun weighing thirteen pounds. African hunters use double rifles going fifteen to sixteen pounds.

The water-cooled Browning gun, thus far a military secret and unlike any other Browning gun, is a belt-fed gun like Browning's old Colt. Unlike the Colt it is recoil-operated, (heretofore the recoil had been used only in the Maxim and Vickers), which means a gun in which the power of the recoiling parts is used to compress the springs and extract the cartridge, etc. The ejection is through the bottom of the receiver—toward the ground instead of in the face of some soldier happening to be beside the gun. The entire gun can be dismounted in a moment without tools.

This gun fired twenty thousand shots without a hitch due to the gun itself, and with but

Firing the Bénet-Mercier Machine Gun

The cartridges are supplied in flat strips of thirty which feed across the gun horizontally, the clip being moved one cartridge at a time by the gun's mechanism. The rate of fire is high, about six hundred shots a minute, which means that a full clip races across the breech of the gun in three seconds. Note the flanges on the gun. These cool it like the flanges cast on the barrel of a motor cycle's engine. The crew must swathe the gun barrel with wet sponges set on wooden handles every three rounds or oftener, which makes a pretty cloud of steam and advertises the whereabouts of the piece in the most disapproved manner

two stoppages due to imperfect ammunition, one cartridge failing to feed in, the other refusing to fire. Consider that this means twenty thousand terrific shocks to the operating mechanism, twenty thousand vicious drives backward of the mechanism when the powder pressure of fifty thousand pounds per square inch rose in the chamber for each shot. So fast does the mechanism of such a gun work that the eye cannot follow the moving parts. Imagine a single-cylinder automobile engine being asked to work twenty thousand times so quickly that the eye can't follow the piston in and out, and started from inertia to top speed in probably one-fiftieth second.

Compare this with the following official record of the Bénet-Mercier at Texas City, in August of 1914, the comparative machine-gun trials between the Bénet—the then standard type in our army—and the light Vickers rifle:

"It was found during these tests that it was practically impossible to obtain a continuous fire of 1000 shots from any of the Automatic Machine Rifles, M 1909 (The Bénet-Mercier). During two of the tests such fire was required, but owing to severe and frequent jams of various kinds, some of which could not be corrected within a reasonable time even by a skilled mechanic on duty with the board, it was necessary to discontinue this particular kind of test in so far as this type of gun was concerned."

Also, said the board, regarding the belt-feed Vickers—the same type as the Browning in feed details:

"The greater number of cartridges in container—250—resulted in a more continuous, concentrated fire from the gun. While the rate of fire of the Vickers gun is slower than that of the service machine rifle—Bénet—the actual number of rounds fired when both types of gun were working satisfactorily was in the proportion of 10 to 6 in favor of the Vickers, due to loss of time in inserting the shorter feed strips of the Bénet automatic machine rifle."

Against this Bénet record of not one thousand rounds continuous fire, the Vickers guns—four of them—were fired more than sixteen thousand times—six thousand rounds from one of them without "a malfunction that could not be easily and quickly corrected by the gun crew."

This resulted in the adoption of the Vickers gun—and now comes the great Browning machine gun of much the same type—belt feed and water cooled—that was fired twenty thousand rounds with but two stoppages, both due to ammunition. The fine Vickers has to take second place.

After the adoption of this splendid new Browning, the Board asked Browning to design one on the same lines but air-cooled for airplane use. Air is efficient for an airplane gun because the rapid motion through the air cools the gun surface, where this is not true on the land. This has been done, and the gun adopted for airplane use. Water cooling is not, of course, practical for airplanes.

Browning's Airplane Gun

Browning filled the order with a fifteen-pound automatic rifle or machine gun, as it really is, gas-operated like his old Colt, and air-cooled. It is fed by a twenty-shot magazine, and, with its very light weight and small magazine, it is as much a true automatic infantry shoulder rifle as it is a

This Is Browning's Colt Automatic Machine Gun

Like all air-cooled machine guns, the Colt has its faults. If you inadvertently leave a cartridge in the barrel after firing a number of rounds, the heat of the gun will cause the cartridge to fire itself in about four seconds, regardless of all the safety devices provided. And yet the Colt is one of the most efficient air-cooled guns made. It is operated by the pressure of the powder gases. The rate of fire is about four hundred shots a minute. The cartridges are fed to the gun by a belt containing two hundred and fifty shots of regulation ammunition

machine gun. It has a wooden stock like an ordinary rifle, and it can be fired from the shoulder, although hardly with automatic fire, because of the unbalancing effect of the series of hard drives of recoil. With the regulating latch set for one-shot fire, the gun fires once for each pull on the trigger, precisely like the well-known so-called automatic sporting rifles and shotguns and pistols which reload themselves by the recoil and fire each time the trigger is pulled.

When the same latch is thrown down to automatic fire, however, the gun fires at a rate of speed higher than that of any known machine gun, and the twenty shots are fired in approximately two seconds! The Bénet-Mercier would take this time or longer; the Colt and Vickers three seconds. The magazine is readily replaced by a filled one.

The Bénet-Mercier Machine Gun

The Benet Mercier gun has been used by our army since 1908. It came originally from the French Hotchkiss factories. It weighed about twenty-eight pounds, which means that it can be picked up and carried by one man in changing position. Benet Mercier machine guns however come as light as fifteen pounds. The gun is operated by the powder gas passing through a port in the barrel [illegible] of the bore [illegible] The gas strikes the head of a piston working in a cylinder like that of a one cylinder gas engine. The backward drive of this piston performs the various operations of [illegible] the cartridge and [illegible] springs, extracting and ejecting the empty shell, cocking the hammer, etc. Then the [illegible] springs drive home the bolt, with a fresh cartridge in the chamber

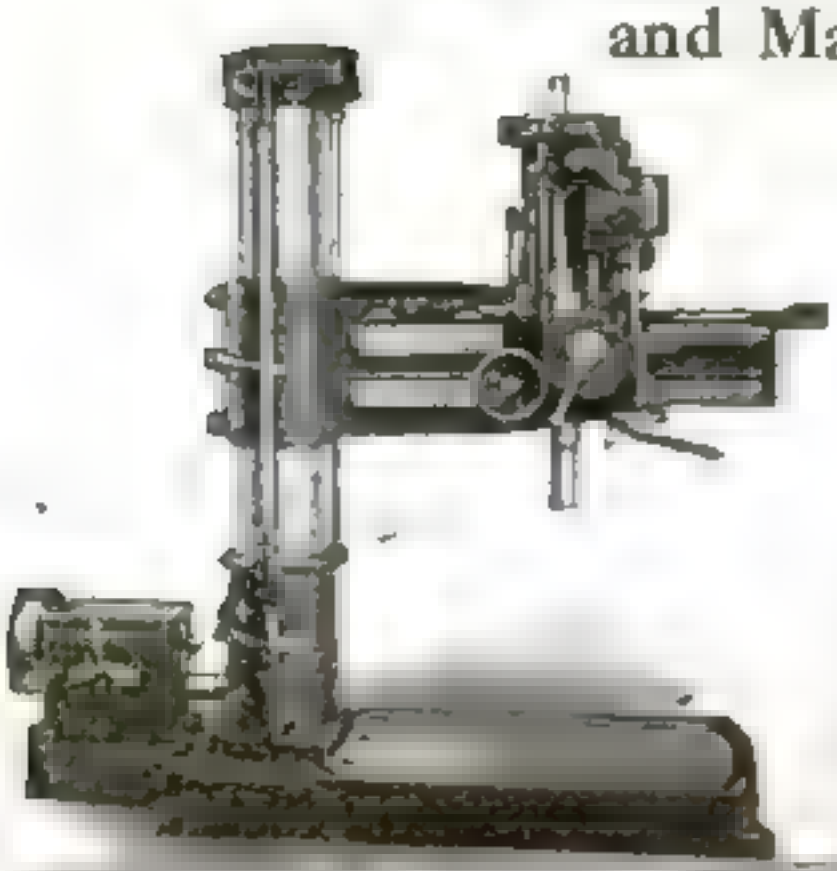
Longer box-magazines—the form in which the cartridges are carried in this arm—can be used, but the twenty-shot is intended for use in the front line, where the firer may have to hug the ground and where a too-long magazine would make the automatic rifle hard to handle.

Consider the automatic rifle section of a platoon, then, each man carrying easily over his shoulder the 15-pound rifle, and loaded with ammunition packed in spare magazines, and with still more in the hands of ammunition carriers. Using one-shot fire, the firing party can easily empty a rifle with aim for each shot in ten seconds. Then, when the rush comes or when it is necessary hurriedly to sweep a trench traverse filled with the enemy, a shifting of the latch and a burst of fire of twenty shots in two seconds! A single burst, and a twitch or two of the muzzle, and a traverse would be cleaned out. Such fire would have to be from the prone position or from the hip. No man can stand up under the repeated recoil of a light machine gun fired from the shoulder.

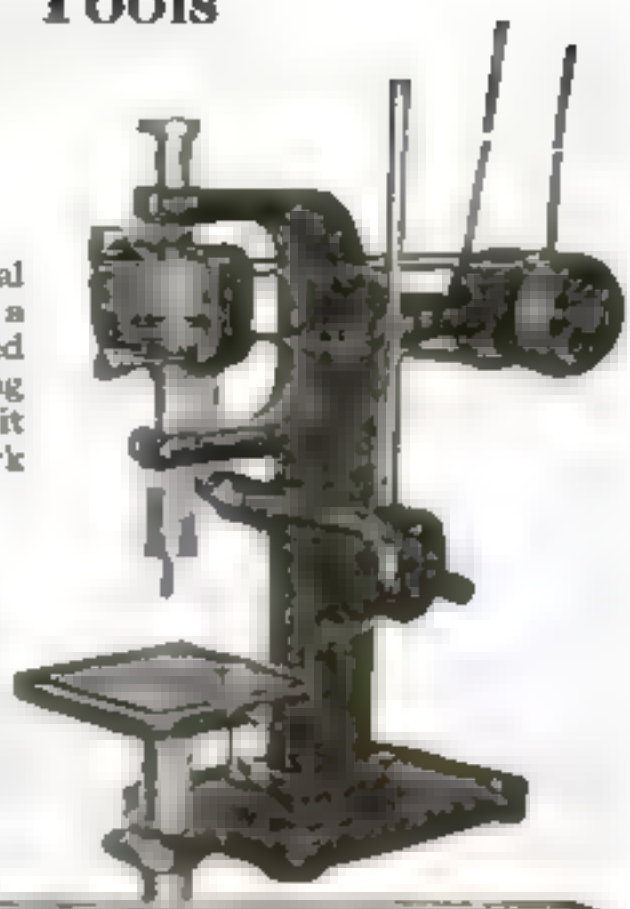
The only competitor the new Browning gun has is the little French Chauchat "the hell-cat," used now in our army, and weighing nineteen pounds. Our experienced officers say even the twenty-six pound Lewis is too heavy for the automatic rifle work in the front line—and now every platoon of an infantry regiment has a machine gun or automatic rifle section—the terms being much the same in these days—the men of which carry light machine guns and ammunition, therefore, just as still another section carries only hand grenades. Some of the little fifteen pound terrors are now coming through the Winchester works.

So came about the crowning triumph of the Yankee, John Browning, designer of the Government's automatic pistol, and now the designer of the three most successful machine guns the world has seen, victors in fair trial over all other machine guns—the Browning water-cooled machine gun, twenty-five pounds in weight, the Browning air-cooled machine gun for planes, still lighter weight, and the marvellous Browning automatic rifle or light machine gun, fifteen pounds.

Why Not Do It with Tools and Machinery?



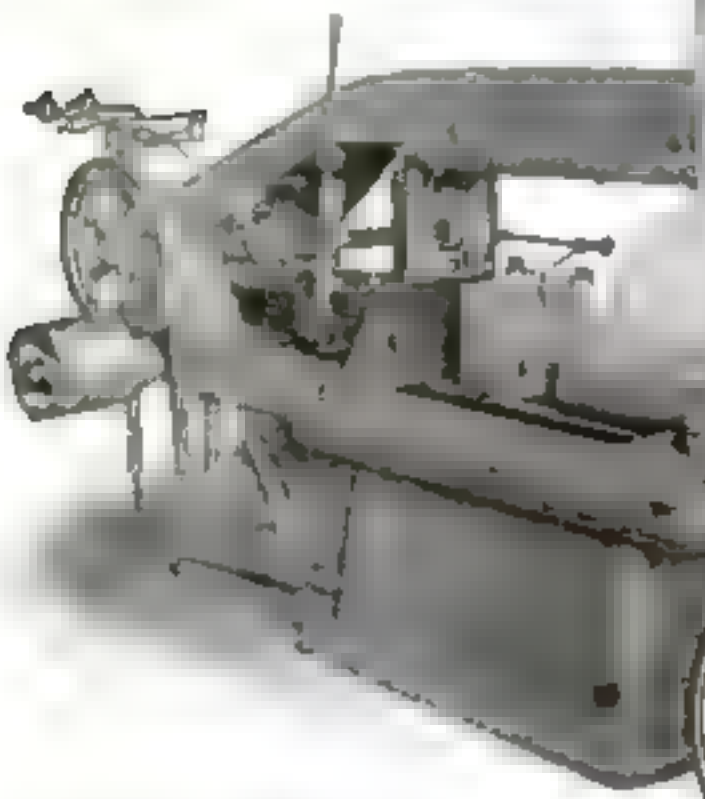
A large radial drill press with a power actuated arm for raising and lowering it to suit the work



With the tapping machine shown at the right reverse is greater than the cutting speed

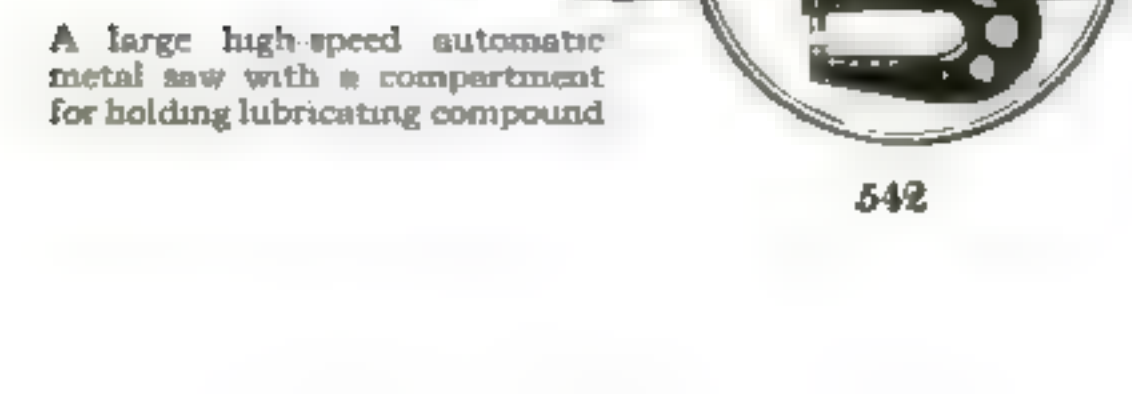
Portable miller to cut recesses in plates used for vessels' sides

An automatic electrical wrench which stops when nut is tight



A brick tongs is shown at center which holds seven bricks at once

This one-half horsepower motor is geared to move thirty ton cover from telescope mounting

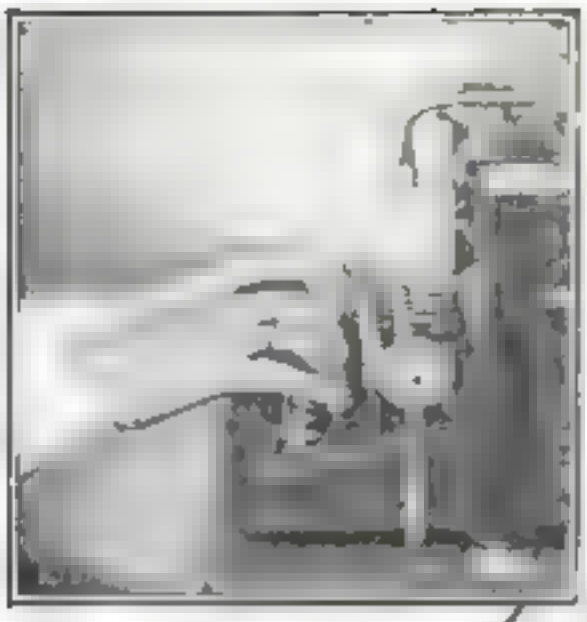


A large high-speed automatic metal saw with a compartment for holding lubricating compound

Direct reading micrometer having disk that can be accurately read at distance of several feet

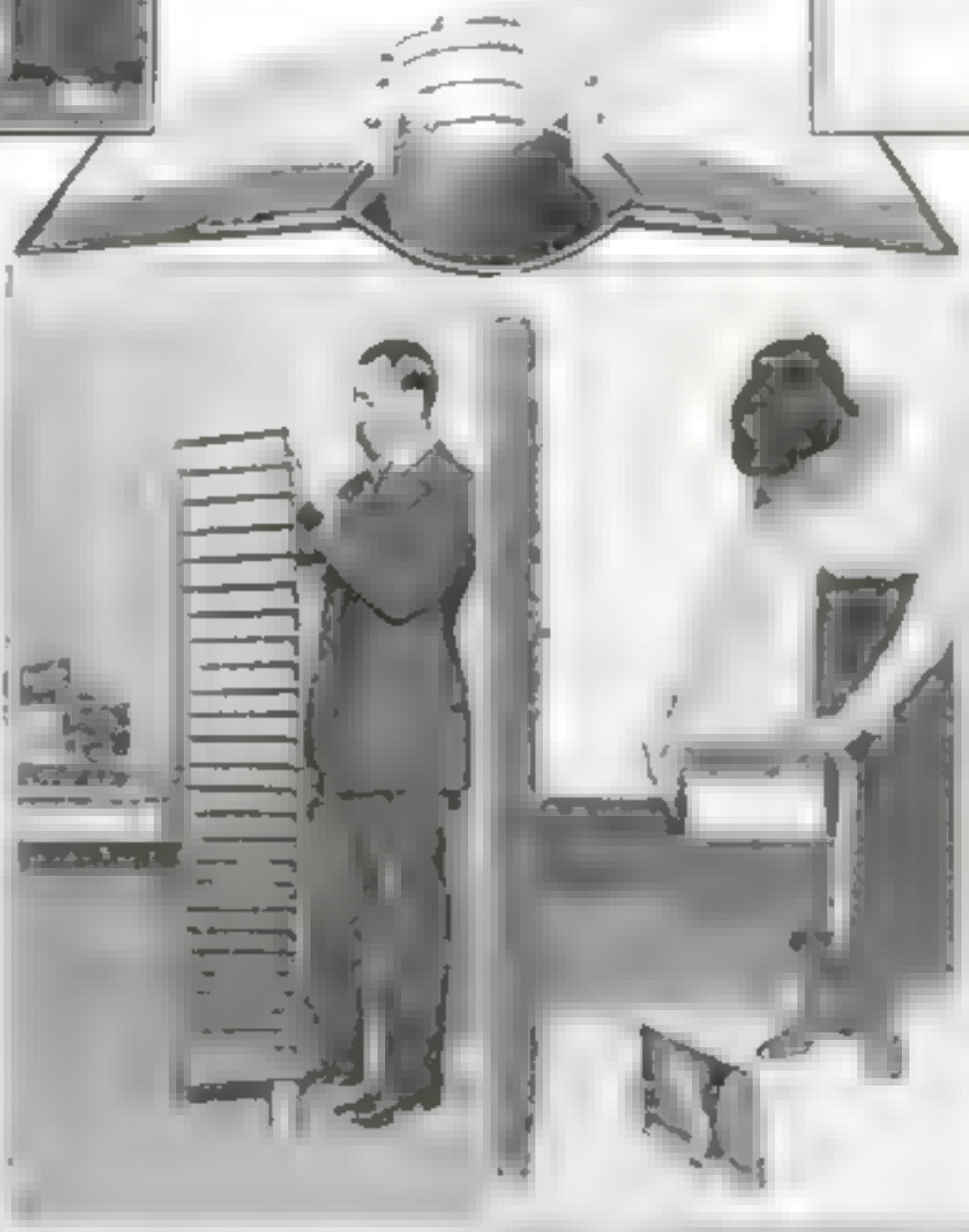
Little Helps for the Office Workman

A flexible and extensible book binder that allows the leaves to lie flat yet locked is shown below



One of the most annoying features of typewriting is to look for an eraser when a mistake is made and not be able to find it. It has to be tied to the typewriter. With this clip it can be kept handy

A new type of paper fastener for the desk. The front part cuts a tongue and turns it back through a slot, fastening several sheets at a time. The back or heel part has a punch for the cutting of round holes



A file for the flat top desk is shown at the right. It has sixty-eight compartments, one for each day of the month, one for each month, one for each letter of the alphabet. It is easily stowed

A narrow follow block for vertical letter files is shown at the left. This block is made of metal and holds the contents firmly compressed, yet when released it can be easily moved forward and backward

Typewriter is kept in desk and drawn out the same as a drawer

A clever design for an ink bottle, paper weight and penholder stand for use in the office

Check writer with five fountain pens signing five checks at once

Boxes of Air to Foil the Torpedo

William T. Donnelly's ingenious method of making cargo-carrying ships unsinkable

By Robert G. Skerrett

THE steamship *Lucia* is unsinkable. At least, such is the opinion of William T. Donnelly, a consulting engineer of New York city and a member of the Ship Protection Committee of the United States Shipping Board. Indeed, this belief is shared by his associates on the Board, and for that reason Mr. Donnelly's special system has been installed upon the ship in question.

The Boxes and What They Do

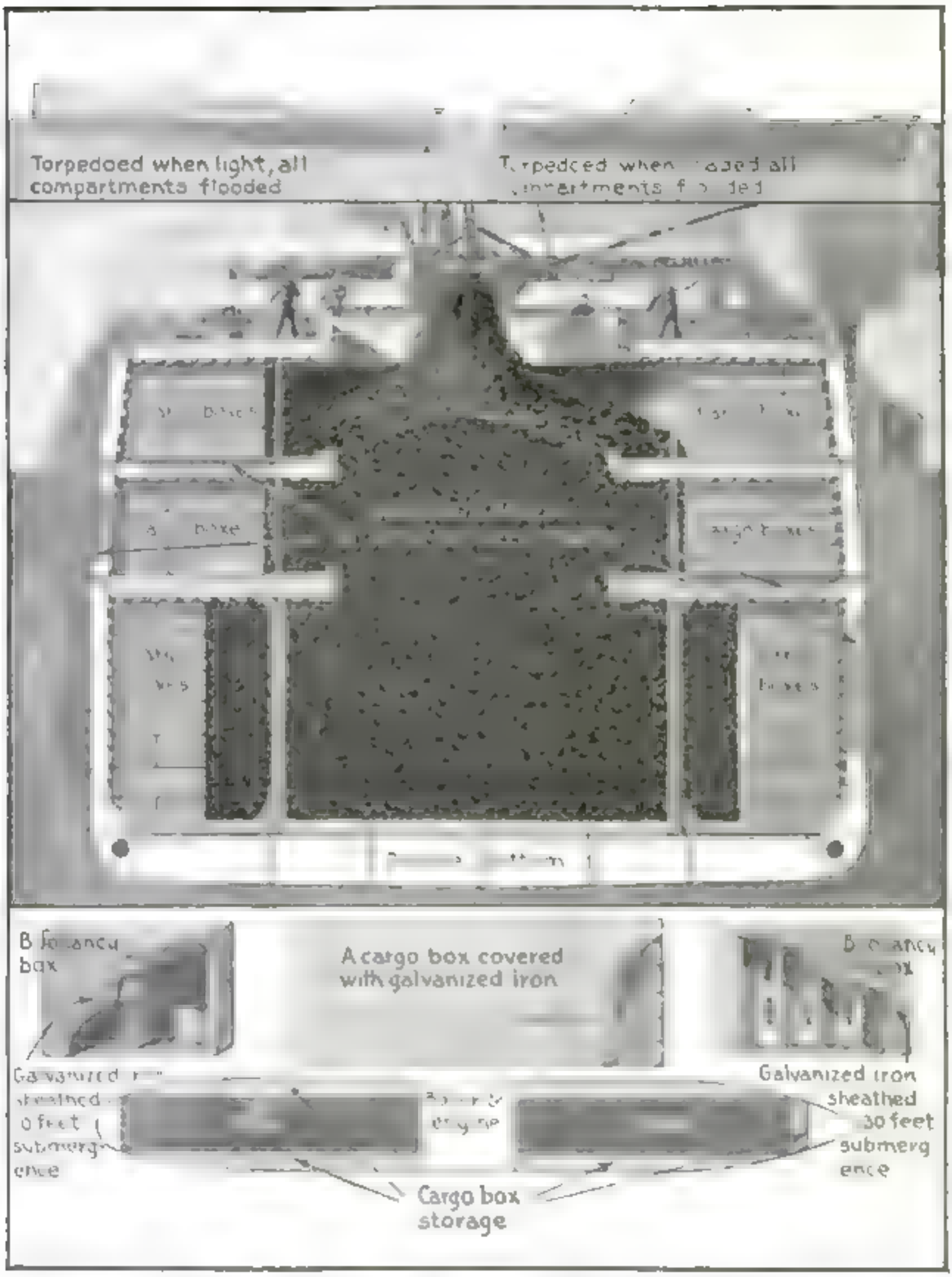
The invention consists fundamentally of a system of portable buoyant watertight boxes, which, when packed in their designed places, form a veritable honeycomb of small air chambers. By thus greatly subdividing the space allotted to them, these boxes necessarily restrict the volume that may be opened up by the destructive gases of a torpedo, and, therefore, limit the amount of water that can enter the craft so damaged.

Maritime law sets a limit to a craft's deep load-line. The underwriters will not issue insurance if that line is submerged by reason of excess weight taken aboard. While this is a very necessary safety measure, still it actually invites peril. For instance, coal represents forty-three cubic feet to the ton while the ordinary baled cotton runs about ninety cubic feet to the ton. Clearly, if a steamer of a given capacity has her compartments entirely filled with cotton, when loaded to her prescribed waterline, those holds could not be more than partly filled when carrying a corresponding weight of coal. And because there would be that volume of unused space, when carrying coal, there would be just so much more room for water to rush in in case the hull were ruptured. This water would destroy the ship's reserve of buoyancy—previously represented by free air space—and cause her to sink. The cotton cargo, on the other hand, because it has less density and more bulk than the coal, would keep out the invading sea and actually buoy the vessel at the surface in spite of very serious injury to her hull.

Cargo Space Is Not Reduced Much

Now, Mr. Donnelly stows the smaller of his portable buoyancy chambers in between the ribs of the craft and up under the decks between the beams, holding the buoyancy boxes in place in both cases by means of wooden slats or "battens," as they are technically called. The boxes are placed where freight would not be packed. These safety chambers are what might be termed a permanent feature of his plan. In order to take care of excess space in the cargo holds, if the weight of the freight and its density are such that the compartments are not filled, the inventor resorts to "cargo boxes" which differ from the buoyancy boxes mainly in the matter of size. The buoyancy boxes average one foot by two feet by three feet and weigh one hundred and three pounds apiece; while the cargo boxes are two and one-half feet by two and one-half feet by six feet and weigh three hundred and eighty-seven pounds. The buoyancy boxes displace four hundred and sixty-five pounds of water, and the cargo boxes displace eleven hundred and fifty-three pounds of water—showing plainly a large net gain in reserve buoyancy. Every box is tested first for airtightness by submerging it in a tank, and then for water-tightness by placing it in a sealed cylinder and subjected to hydrostatic pressure corresponding to the position in the steamer.

The complete equipment of boxes for the steamer *Lucia* costs about one-tenth of the building price of the ship. Mr. Donnelly estimates that a vessel should normally be worth ten times her cost to her owners through the service she can render in the course of an average useful life. Therefore, his safety feature involves an outlay of only one per cent. of her probable returns.



How William T. Donnelly Intends to Make Ships Unsinkable

Much has been heard lately of unsinkable ships, but after the *Titanic* disaster the public became skeptical. However, Mr. William T. Donnelly of New York, has recently advanced a new and plausible idea. Buoyant boxes are to be packed into allotted spaces, thus adding enormously to the buoyancy of the vessel. The boxes will be watertight and airtight and very strongly made. They will be placed as an additional wall between the cargo and the vessel's side. When traveling light the buoyancy boxes would suffice to keep her afloat, even though badly damaged. If loaded they would enable her to keep on the surface even though all the rest of her free space were flooded. The boxes are to be standard and stored at shipping terminals so that they will always be on hand to fill any spare space not taken up by the cargo. The steamer *Lucia* has already been fitted with these new boxes.

Hooverizing Daylight

Not advocating a bedless day, but suggesting the readjustment of hours

These timepieces from Grandfather to Baby Ben, will all have to be reset if we adopt the daylight saving measure. In this article the whole subject is discussed. Daylight-saving has been advocated ever since the days of Benjamin Franklin, when that worthy scored the citizens of Paris for their slothfulness

THE project of advancing the clock in summer in order to persuade slothful humanity to keep early hours at that season, after nearly a decade of unsuccess in getting itself taken seriously, has suddenly come to fruition under the stress of war conditions, and is an accomplished fact over the greater part of the civilized world.

A certain modest representative of the building trade, now deceased, must have chuckled in his grave when Representative Borland referred to him the other day, in Congress, as "the late William Willett, the noted scientist of England." Willett put forth his daylight-saving scheme, in a form somewhat different from that eventually adopted by the British Government, in the year 1907. The first daylight-saving bill was introduced in the House of Commons in the year 1908. Presently similar projects began to crop up all over the world. Most scientific men ridiculed them, but many of these authorities have now been converted. Then came the war, and daylight saving was one of its many startling products.

It would be quite impossible within the limits of a brief article to set down all the pros and cons of this scheme. The pros are generally familiar, because they have been embodied in numerous circulars, widely disseminated by chambers of commerce, and faithfully reflected in our commercial-minded press. The cons are less well understood; but more will be heard of them when America is undergoing her first summer of dislocated time. A year or two of experience will be worth centuries of academic discussion in enabling us to decide whether we wish to save daylight indefinitely.

Western Europe has now had two years' experience with the plan, and the results are those that might have been expected under existing conditions. They depend to some extent upon latitude. In far northern countries there was really no good reason for adopting the scheme, except to bring their time-schedules into agreement with those of their southern neighbors. In high latitudes it is impossible in summer to limit sleeping time to the hours of darkness, because daylight prevails through the greater part of the night, or all of it, according to date. Hence the Norwegian Government reports the plan a failure, and similar but unofficial reports have come from Scotland.

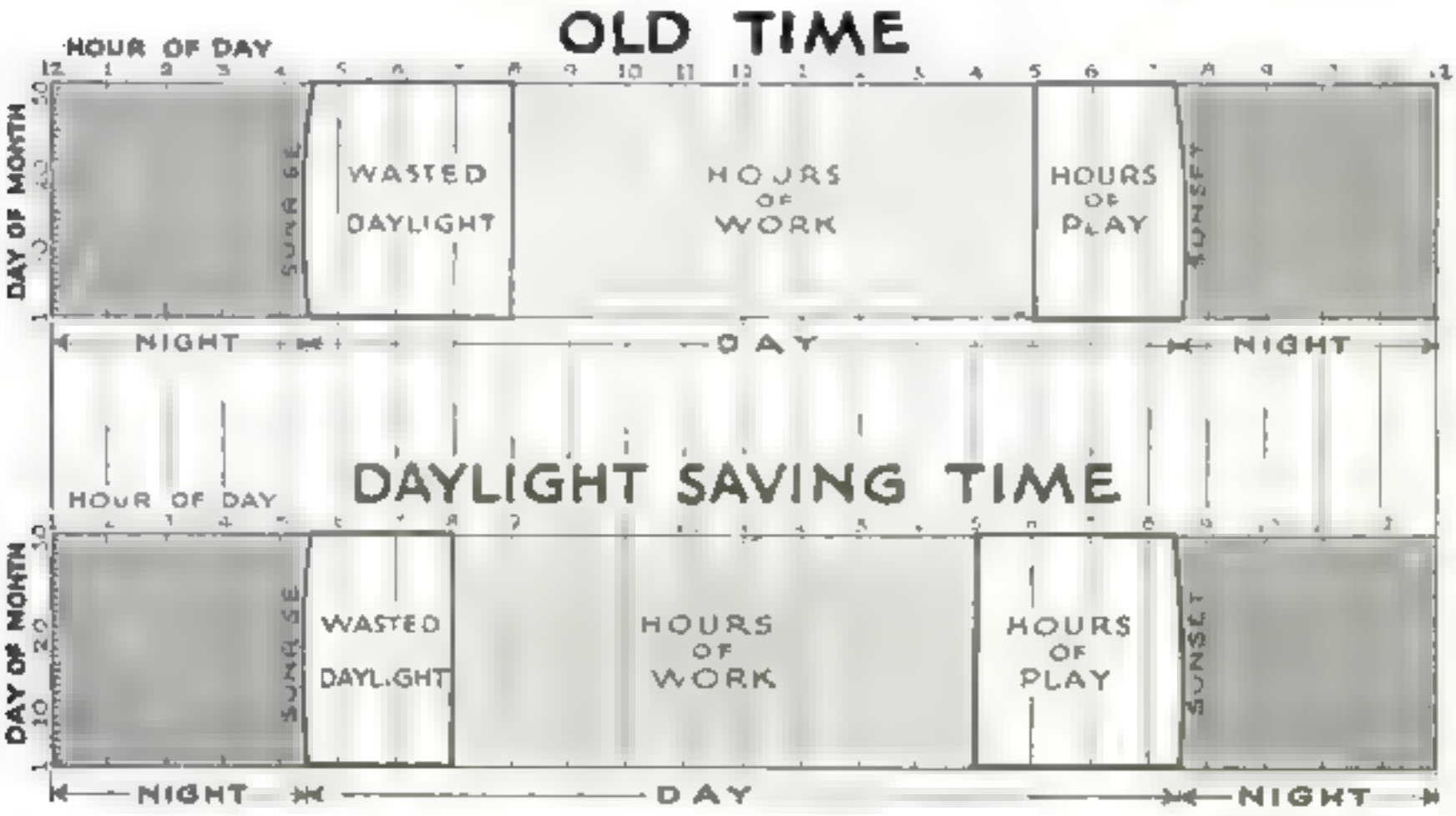
Elsewhere the plan has undoubtedly saved fuel, and it seems to have conduced to the health and comfort of a considerable part of the population. In the United Kingdom it is claimed that in the four and a half months that "summer time" was effective in 1916, the saving in gas alone represented 260,000 tons of coal, and reduced the expenses of con-

sumers by $2,375,000. Electric light companies reported a reduction of output averaging about 20 per cent. The saving in illuminating oils was reported at 2¼ per cent. of the annual consumption. In France the saving in fuel used for illuminating purposes was estimated at ten per cent. of the annual consumption. In Germany the municipal gas works at Berlin reported a decrease during May and June, 1916, of 508,500 cubic meters, in spite of the fact that 18,000 new gas meters were installed during the first six months of the same year, and the records from January to April showed an increase of 2,400,000 cubic meters of gas as compared with 1915.

Estimates vary as to the saving of fuel we may hope to effect by the adoption of the daylight-saving plan in the United States. When this phase of the question was discussed in hearings before a Congressional committee, Mr. R. I. Brunet, of the Rhode Island Committee on Public Safety, declared that in the city of Providence alone an annual saving of $60,000 was anticipated, and that in the country at large the saving would amount to something like $40,000,000. The Boston Chamber of Commerce estimates that the country will save $100,000,000 annually in the use of artificial light, on the basis of extending the plan to the entire year. The city of Cleveland is said to have saved $200,000 during the first six months after changing from Central to Eastern Time (thus permanently advancing the clocks by an hour).

By beginning their day an hour earlier than has heretofore been customary, people gain an extra hour of daylight after the regular day's work is over. This affords greater opportunities for out-of-doors recreation, and the change seems to be popular in middle European latitudes, except with the agricultural population, which has expressed some dissatisfaction at being obliged to advance a working schedule which was already well adjusted to the daylight period. Workers in other lines have, in some cases, enthusiastically described the effects of the plan as "giving them a Saturday half-holiday all the week."

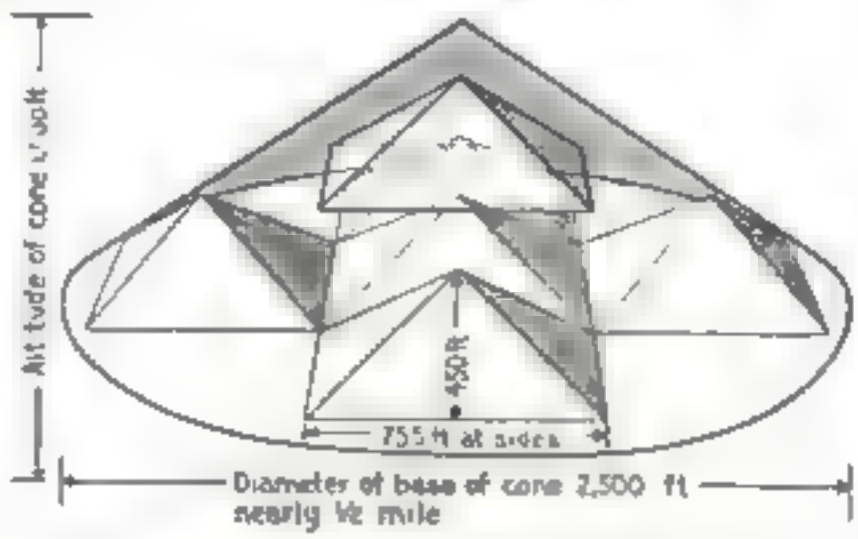
It is also reported in England that the extra daylight in the afternoon has encouraged the cultivation of gardens. Much stress has been laid upon this feature of the scheme in the United States, where it is hoped that daylight-saving will increase the general food supply and also help the individual citizen to solve the problem of high prices by raising part of the food needed for his own table. It is not at all clear, however, why the advancing of the working hours in



Here are the twenty-four hours graphically illustrated. Notice that the work hours remain the same but the play hours increase. It is switching an hour from the morning to the playtime

shops, factories and offices should not have exactly the opposite effect—by depriving the employees of the opportunity they previously enjoyed of working in their gardens *before* beginning their regular occupations.

Apparently the procedure of setting the clock forward and backward has not caused much trouble on European railways. Whether, with our much larger proportion of single-track lines, we can follow the same plan with impunity is still uncertain.



England saved 300,000 tons of coal in one year. The diagram shows the size of the heap. It is equal to a 215-foot cube

Obviously daylight-saving has much to commend it. What can be said against it? Many arguments urged by its opponents are fallacious and frivolous. It has been called unscientific, but it is purely a practical measure, with which science has little to do; it has been looked upon as immoral, because a certain amount of "deception" is supposed to be involved in it—as if there could be any deception in a mere change in conventional time-keeping publicly established by law!

The real argument against the daylight-saving scheme is that civilized humanity has a strong liking for artificial light — even though it costs money. Many—perhaps most—of us have no desire to go to the bed with the chickens, and it is a plausible hypothesis that the daily alternation of natural and artificial light has a beneficial effect upon health, analogous to that which we derive from the changeable "cyclonic" weather of middle latitudes, constituting the most stimulating of all climates, though it is hardly parallel.

That thrifty old soul, Benjamin Franklin, was an enthusiastic daylight-saver, and one of the first to formulate an opinion on the subject. In a much-quoted essay he took the people of Paris to task for lying abed hours after sun-up—a practice resulting in needless expenditures for candles.

Electricity Makes the Winding of Bandages Easier

IT is only fit that electricity, which is so widely used as an aid in the destructive work of the war should also contribute its share to the efforts of healing the wounds caused by the war. An electrical contrivance shown in the picture, is now used in the workshops of the Red Cross for expediting the formerly slow and laborious work of winding bandages. It is a reel of simple construction, driven by a small electric motor supplied with power from any household lighting circuit.

This little machine winds thousands of bandages a day for our soldiers

This contrivance obviates much handling of the bandages and so prevents, to a great extent, their contamination. The greatest advantage, however, is its speed, which is a boon when requisitions for many thousands of these bandages have to be rapidly filled.

Sample House in a Suit Case for Real Estate Drummers

THE drummer or traveling salesman with his indispensable sample case containing specimens of the goods he is trying to sell is a familiar figure everywhere in this country. There are many kinds of salesmen on the road. Some sell dry goods, some offer goods that are not so dry, others sell hardware, groceries, cigars or other merchandise. But who has ever heard of a drummer selling houses? Yet, there are such and, moreover, like other drummers, they carry samples of their goods in their trunks or sample cases.

The set-up model gives a good idea of the appearance of the new house

An Eastern firm, which makes a business of building sectional houses that can be set up and taken down again whenever desired, has conceived the ingenious plan of selling these houses by samples which their drummers carry with them on their tours. The samples are cardboard models, printed in colors and partly cut out, so that they can easily be put together even by inexperienced hands. The advantage of this method is evident. Ground plans and even perspective drawings cannot be visualized readily by the average person. By showing models the salesmen find no difficulty in interesting their customers. The very fact of a man carrying a house in his sample case excites curiosity at the commencement, and coupled with interesting sales talk forms a great attraction.

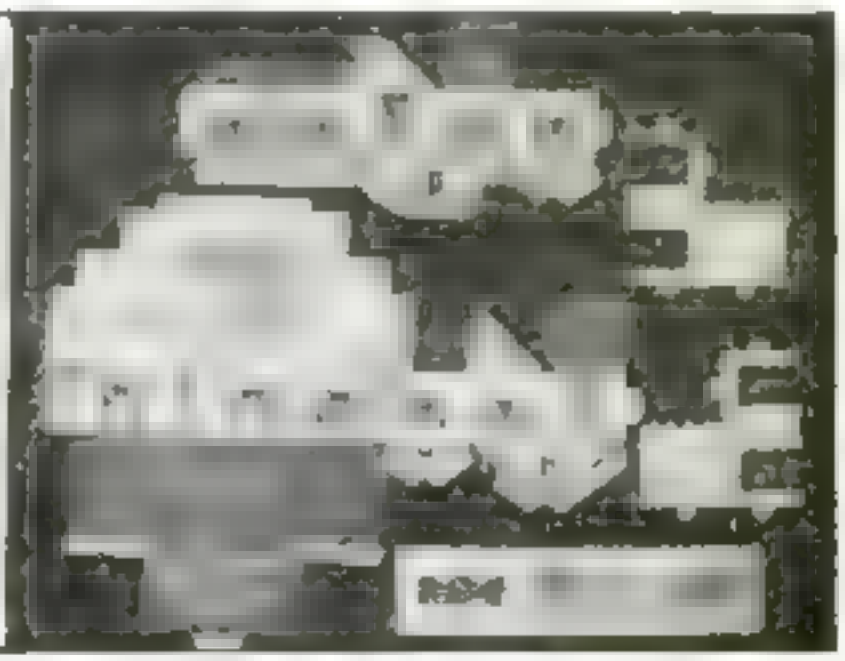
Will You Give the Navy An Eye? They Want 'Em Badly

THE Navy Department in Washington has issued an urgent appeal to all citizens owning binoculars, spy-glasses or telescopes to place these instruments at the disposal of the Government. The Navy is still in great need of such optical instruments. The use of the submarine has so changed naval warfare that more eyes are needed on every ship, in order that a constant and efficient lookout may be maintained.

Heretofore practically all optical glasses used in the United States were imported from Germany, France or England. The war has put a stop to the importation of these articles and as there is no longer any supply on hand, the Government finds it necessary to appeal to the patriotism of private owners.

Citizens, willing to come to the aid of the Navy, should send their field glasses, binoculars or telescopes, securely tagged and giving the name and address of the donor, by mail or express to the Hon. Franklin D. Roosevelt, Assistant Secretary of the Navy, care of Naval Observatory, Washington, D. C. A permanent record of the donation will be kept and the article will, if possible, be returned after the termination of the war. For each article accepted the Government pays a nominal fee of $1. Now then! Rally 'round, and altogether, boys!

The bungalow actually built, with slight change in the construction of the pergola



Showing the model, printed on cardboard, in its sections, before it is put together

Prizes for Labor-Saving Automobile Improvements

$100 for the best labor-saver and $50 for the next best. Read these rules

MORE than four million Americans own automobiles. Most of these owners run their own cars and make their own repairs. Many of them have undoubtedly invented ingenious attachments about which others would like to know, and some have unquestionably made improvements about which the great automobile manufacturers would like to know.

All this latent, unrecognized inventive talent should be brought to light, especially at a time when we need inventions. And so the POPULAR SCIENCE MONTHLY has decided to inaugurate an automobile contest. It offers two prizes —one of $100, the other of $50—to be awarded in accordance with the rules published below. The prizes will cover at least part of the cost of patenting the inventions. The devices which win the prizes will undoubtedly be of sufficient commercial merit to warrant an automobile manufacturer purchasing the patents by which they are protected.

The main purpose of this contest is to encourage automobile owners and users to disclose their ideas.

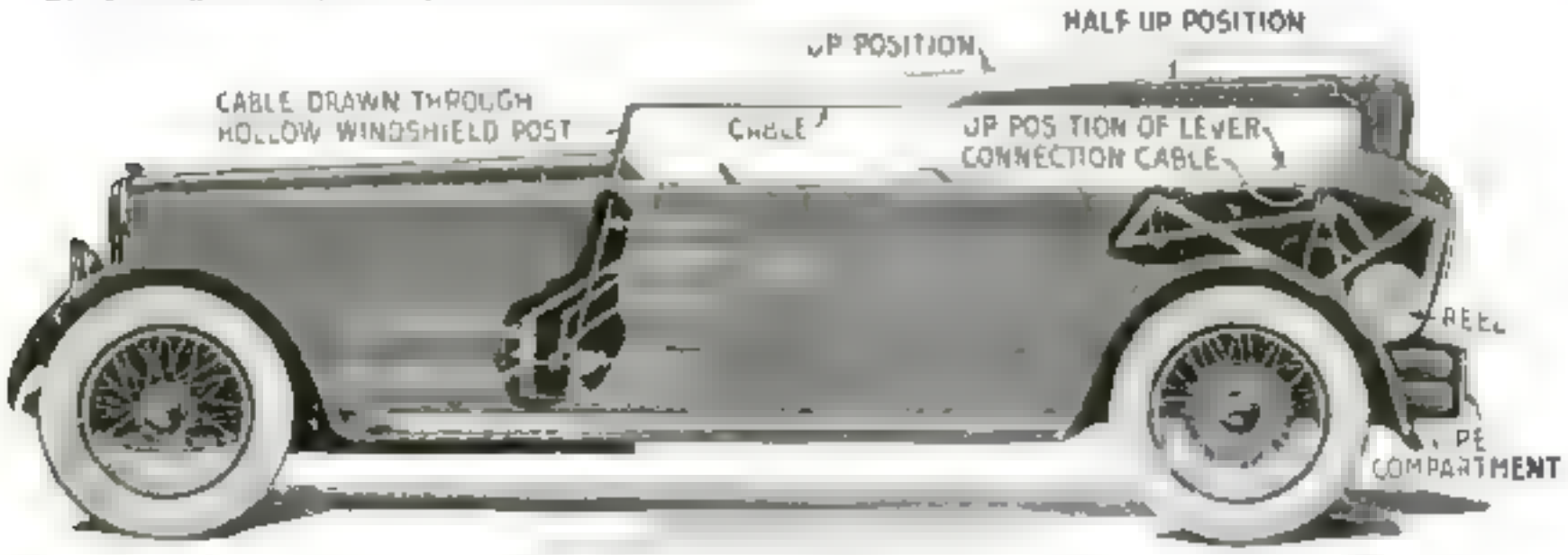
Rules Governing the Contest

1. The device offered for consideration must be labor-saving in character. In other words, its use must result in a saving of the muscular effort required to run a car or to maintain it in good condition.

2. The device offered for consideration must be commercially new. In other words, it must not be purchasable in the open market.

3. The device submitted by a contestant may be a simplification or improvement of an invention now incorporated in standard automobiles. Thus, it may be an engine starter, an electrical or hydraulic gear shift, a brake, a mechanically raised body top, a mechanical clutch throw-in, etc. But always, it must be commercially new. The accompanying illustrations with their captions will give the prospective contestant an idea of the kind of labor-saving device the POPULAR SCIENCE MONTHLY editors have in mind.

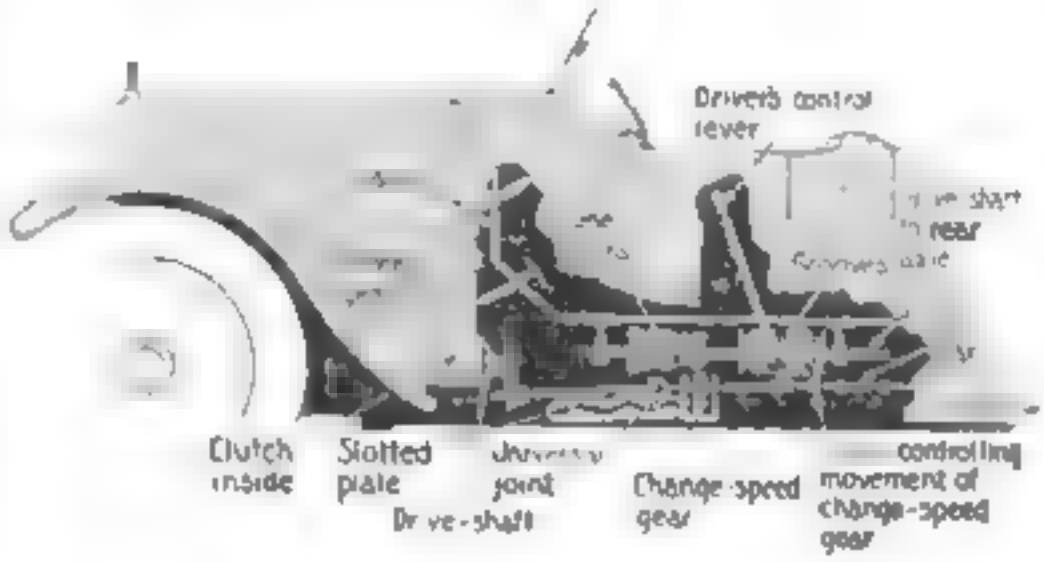
4. Contestants are not limited in the number of devices which they may submit. But only one device can possibly win the first prize and only one the second. The contest is open to everybody.



Here is an excellent instance of what we mean when we speak of a labor-saving device. This hood-raising mechanism does away with all muscular effort, beyond throwing a lever, as it consists of a method of raising and lowering the hood by means of power developed by the engine. Your drawing need not be as elaborate as this, but it should clearly show essential features. We will work it up in the form here shown

5. The labor-saving device submitted must be clearly shown in one or more views. The drawings need not be made by a skilled draftsman. It is sufficient that they should be intelligible. While pencil sketches will be considered, contestants are requested to make their drawings in ink on bristol board. The views should be sufficient in number to set forth the construction and general arrangement of the parts clearly. The contestant's name and address should appear on each sheet of drawings.

6. The drawings must be accompanied by a description, preferably typewritten, in which the construction and operation of the device is clearly given. It must be written on one side of the paper only, and it should not be more than five hundred words in length. The name and address of the contestant should appear in the upper left-hand corner of the first sheet of the written description.



This illustration also shows a clearly detailed drawing of a device that enables a driver to change speeds without expending energy to throw the clutch in and out It consists of three gears arranged on the surface of a cone and parallel to the base. Spiral gears connect the three main gears and allow one gear, driven from the main shaft to be slid from the smaller of the gears on the frame to another and back again without throwing out the clutch as is usually necessary

7. The drawings and description entered by contestants must be received by the POPULAR SCIENCE MONTHLY not later than 5 P. M. on April 10th.

8. The judges of the contest will be the editors of the POPULAR SCIENCE MONTHLY.

9. The following devices and processes are barred from the contest:

All compounds to be mixed with the fuel in an attempt to obtain more power.

All auxiliary air devices and similar equipment designed to save fuel by making the mixture leaner.

All parts of the engine, clutch, gear set, transmission mechanism, rear axle, steering wheel and any other part of the chassis, unless a reduction in the amount of muscular energy at present expended to drive the average automobile is obtained.

10. A first prize of $100 will be awarded to the contestant who, in the opinion of the judges, has produced the simplest, and most desirable labor-saving device.

A second prize of $50 will be paid to the contestant who submits the device next in order of merit.

11. The winners of the contest will be announced in the June issue of the POPULAR SCIENCE MONTHLY. A description of the device which won the first prize will appear in the same number, together with the name of the winner. In the July issue of the POPULAR SCIENCE MONTHLY a description of the device which wins the second prize will be published together with the name of the winner.

12. The editors of the POPULAR SCIENCE MONTHLY shall have the right to publish meritorious devices which do not win a prize. The regular space rates will be paid to the contestants who submitted the drawings and descriptions of devices thus selected.

13. Each contestant retains full property rights in the invention that he submits. The only restriction is that imposed by Rule 12.

14. When a contestant submits more than one device the description and drawing of each device must be sent as a separate unit.

15. No manuscripts or drawings will be returned to contestant unless return postage is enclosed on submission.

16. Address your drawings and specifications to the Motor Contest Editor, POPULAR SCIENCE MONTHLY, 225 West 39th Street, New York.

Please follow the above rules carefully.

© Western Newspaper Union

When the supply of checkerboards ran out the Y. M. C. A. thought of using up old linoleum

Remember That Old Checkered Bedroom Linoleum?

WHEN the United States entered the war and hundreds of thousands of young men were drafted into the service of their country many questions arose which had to be solved. The problem of equipping, housing, arming and training the young soldiers and of feeding them in the camps and training quarters and later at the war front, devolved upon the government. Public spirited citizens and patriotic organizations undertook to provide the boys with entertainment and to supply small luxuries.

The Young Men's Christian Association decided to furnish checkerboards and men and employed a number of women to prepare the games. As the supply of checkerboards, formerly imported from Germany, was soon exhausted, boards were made by mounting old-fashioned checkered linoleum on cardboard.

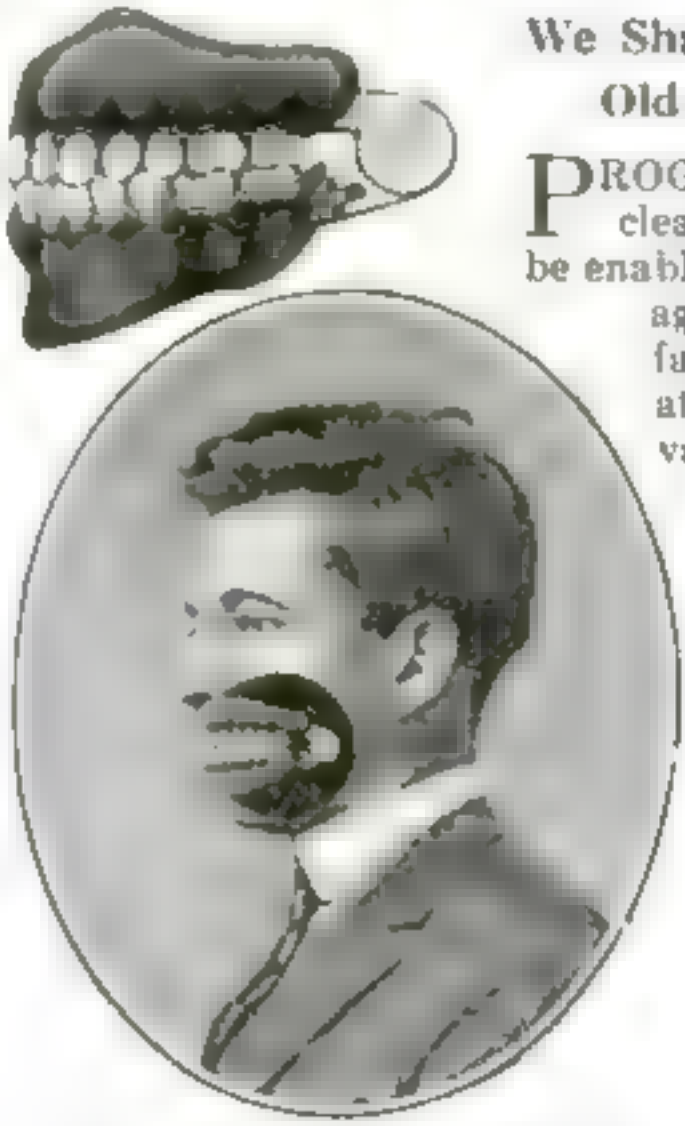
Inflicting Pain to Resuscitate Victims of Electric Shock

TO the uninitiated, the treatment which a workman suffering from an electric shock receives at the hands of his co-workers is inhuman and brutal. When a lineman, for instance, stringing primary wires, has received a shock, which caused him to lose his balance and fall to the ground apparently lifeless, the first thing his working mates do is to take firm hold of the ankles of the limp body, raise it until the entire weight rests upon the back of the neck and then let it drop again. Next they will take a pair of connectors or any other heavy object and hammer the soles of the victim's feet without removing the shoes. While this is being done another comrade will pry open the mouth and yank forward the tongue, which is invariably swallowed in electric shock. By this time unless the man was instantly killed, he has recovered consciousness, the successive shocks of pain having in some way counterbalanced the effects of the electricity.

We Shall Eat When We Grow Old and Lose Our Teeth

PROGRESS in dental science clearly indicates that we shall be enabled to masticate food in old age more readily than our forefathers could. Inventors are attacking the problem in various ways, and in some recent experiments the attempt is made to imitate nature by hinging the upper and lower mouth plates in the manner shown.

A coiled spring within the hinge separates the plates when the mouth is opened. Provision is made also for the side movement of the lower plate by employing a horizontal hinge. This takes care of the usual grinding process in eating.



How the new kind of "false teeth" would appear when inserted in the mouth of a person

Oh, Henry—What Makes Them Go 'Round?

PRETTY young girls passing store windows in which a new advertising contrivance is being displayed have asked that question; old people have asked it; everybody asks it. It gets attention from all sides.

The machine recently patented by H. J. Herberts, consists simply of a polished cylinder mounted in an upright position, and resembling a restaurant coffee urn in size and general appearance. Inside an armature-like electromagnet revolves, throwing a strong magnetic field through the thin outer shell. Then when objects containing steel or iron are thrown against the shell they cling to it and move around and around it along with the magnetic field, in spite of the fact that the shell itself does not rotate. Articles journeying endlessly around the cylinder are objects of great curiosity.

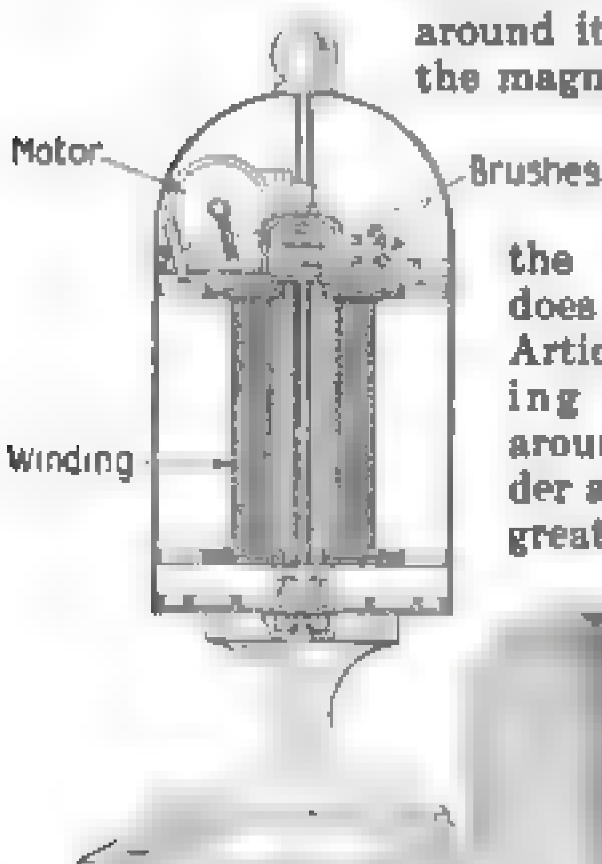


Diagram gives idea of general principles actuating the magnetic advertising contrivance

Any article which contains iron and is not too heavy will revolve 'round and 'round the drum

How Many of These Words Can You Define?

1. orange	27. muzzle	52. [illegible]	76. flaunt
2. bonfire	28. quake	53. mosaic	77. declivity
3. roar	29. civil	54. bewail	78. fen
4. gown	30. treasury	55. disproportionate	79. ochre
5. tap	31. reception	56. dilapidated	80. exaltation
6. scorch	32. ramble	57. charter	81. incrustation
7. puddle	33. skill	58. conscientious	82. laity
8. envelope	34. misuse	59. avarice	83. selectman
9. straw	35. insure	60. artless	84. sapient
10. rule	36. stave	61. priceless	85. retroactive
11. [illegible]	37. regard	62. swaddle	86. achromatic
12. [illegible]	38. nerve	63. tolerate	87. ambergris
13. eyelash	39. crunch	64. gelatinous	88. casuistry
14. [illegible]	40. juggler	65. depredation	89. paleology
15. [illegible]	41. majesty	66. promontory	90. perfunctory
16. curse	42. brunette	67. frustrate	91. precipitancy
17. guitar	43. snip	68. milksop	92. theosophy
18. mellow	44. apish	69. philanthropy	93. piscatorial
19. pork	45. sportive	70. irony	94. sudorific
20. impolite	46. hysterics	71. lotus	95. parterre
21. plumbing	47. Mars	72. drabble	96. homunculus
22. outward	48. [illegible]	73. harpy	97. cameo
23. lecture	49. shrewd	74. embody	98. shagreen
24. dungeon	50. forfeit	75. infuse	99. limpet
25. southern	51. peculiarity		100. complot
26. noticeable			

If you can define seventy-five of the total number of these words you are a "superior man"

Have You a Supermind? If So, You Can Define These Words

DR. LEWIS M. TERMAN, professor of education in Leland University, has introduced a new intelligence test which is said to give good results.

The words in the accompanying list were selected at random from the dictionary and arranged according to their approximate difficulty. The person is asked to begin with the simplest words, giving their definition and continuing through the list until he can no longer define them.

The test is based upon the assumption that a person's intelligence is proportionate to his vocabulary and that the ability to define a certain number of words may be accepted as an index of the person's vocabulary. The average adult can define sixty-five per cent. of the words, representing a vocabulary of 11,700 words, while the superiof adult, who can define seventy-five or more of the words, commands a vocabulary of 13,500 words or over.

Moving X-Ray Pictures

See your joints move and your heart beat on the screen

This fracture is frequently unknown to the patient. He rubs it—and walks lame for good

MOTION radiography, a subject of intense interest, both to the professional world and to the laity, has been unsuccessfully attempted for the past eight years. Scientists, with the aid of the fluoroscope, have been able to see the inner working of the human body. The fluoroscope is a fluorescent screen having a hood for the protection of the physician's eyes. With this instrument it is possible to see the shadows cast by objects in the path of the X-ray.

Using X-rays to locate a fracture of the forearm. The rays can penetrate a wall

Dr. E. L. Crusius of New York city, after months of experimenting has accomplished motion radiography to the extent of showing the joints in motion. He is now experimenting to show the pulsations of the heart, the peculiar wave-like motion of the stomach in digestion, the expansion of the lungs in breathing and other organic motions in the human body.

Dr. Crusius hopes to be able to give his findings to the Government within a short time. Now that the X-ray has entered the motion picture world, the general public will be able to see how great an assistance the X-ray can be to the physician. This is especially true in surgical work in the army for tracing bullets and locating fractures.

As an example of the benefit to be derived from an X-ray examination, take the case of a fracture which is very common. This fracture is generally caused by dropping a heavy object on the foot. The injured person usually binds up the foot after rubbing on some liniment. That one of the delicate bones may be broken never occurs to him. The result of this is that the bone grows together in an abnormal position, so that all the rest of his life the owner of the foot experiences difficulty in walking. An X-ray would have revealed the fracture, the bone could have been set in the proper position and in a short time the patient would have been as well as ever.

The X-ray machine used by Dr. Crusius in his work generates five hundred thousand volts. The rays are exceedingly powerful, in fact they can penetrate a six-foot stone wall.

The exploration of one's anatomy by the X-ray is accomplished without any more pain or unpleasant after effects than would be experienced in having a photographer take an ordinary, look-pleasant-please photograph. As the X-ray is a straight ray and cannot be turned or deflected in any way, the great difficulty in making motion radiographs has been to get a screen placed between the X-ray and the camera that would not fog the film and at the same time would show the image. Dr. Crusius has accomplished this.

Section of motion-picture film of a radiograph

The Forest Skyscrapers of Australia

THE tallest of California's "big trees" is 325 feet in height, but among the great gum trees of Australia many specimens are more than 400 feet in height, and one, which was felled in southeast Australia, measured 471 feet—the tallest tree on record. Gum trees grow very rapidly.

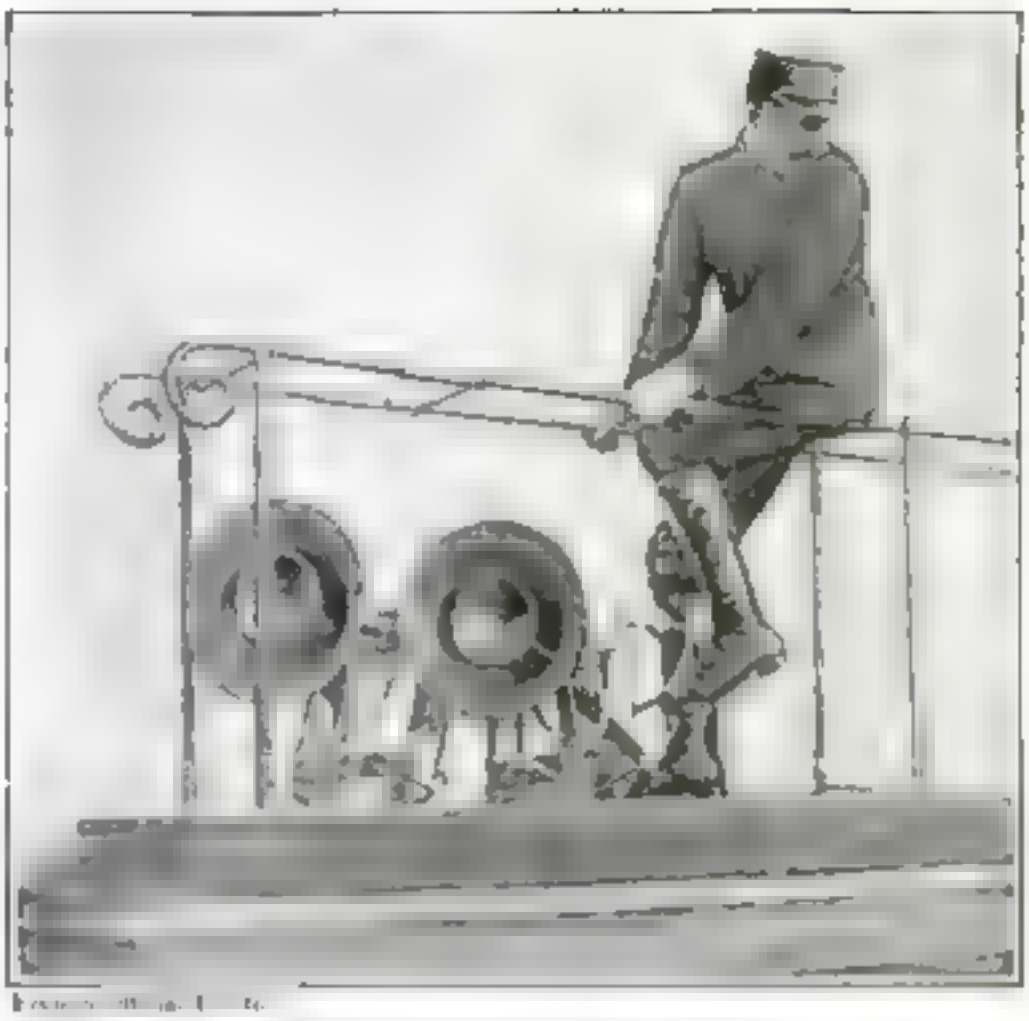
A Motorcycle as a Vibrationless Tripod

BREATHES there the photographer who has not at some time or other "lost his religion" because the wind has shaken his tripod and spoiled a plate? John Edwin Hodd, a Los Angeles press photographer who uses a motorcycle for getting about, has overcome this difficulty so far as exterior views are concerned, by the use of a universal jointed kodak fastening attached to the handle bar of his machine.

The motorcycle is placed on its stand at a convenient distance from the object to be photographed, and by the use of the universal joint the camera is pointed in any direction or at any angle. Attaching or detaching the instrument is but the work of an instant.

Because of the great weight of the motorcycle the camera is held perfectly rigid even in a strong wind. Clear-cut, perfect pictures are the result, and the necessity of carrying a tripod is avoided. The attachment is not in the way.

This press photographer uses his motorcycle as a firm, portable camera tripod



Sirens on top of the Equitable Life building in Paris give warning when German raiders are approaching

Sirens Give Warning of the Approach of Raiders

IN the French cities warning of German air raiders is given by sirens of different construction, some electric, others worked by compressed air or steam. The sound of these sirens is so powerful and penetrating that it can be heard for miles even under unfavorable conditions. Lookouts are maintained at elevated points and day and night close watch is kept upon the horizon line in the direction toward the enemy.

Paris itself, however, has been almost immune from aerial attack. To cross the anti-aircraft guns and to elude the patrolling airplanes is practically an impossibility since the retirement of the enemy.

Why Tanks Are Giant Caterpillars

Armor? The Caterpillar has it. Traveling treads? The Caterpillar has them too. Machine guns? It has a poison squirt-gun

By John Walker Harrington

THE motion of the most formidable and terrifying of modern war machines has often been compared with that of the lowly larva from which comes the radiant butterfly. This famed cruiser of the battlefields might never have been, but for the invention of the farm tractor of Benjamin Holt with its caterpillar tread. Through the courtesy of Captain Haig, of the British Army, who is here demonstrating the pride of the English arms, the writer was permitted to spend nearly an hour within the Britannia, and at every point he was more and more impressed with the idea that not only does the tank resemble the caterpillar in movement, but that there are strange likenesses in structure, in armor, and even in control between the two objects.

The tank is a high-powered, armored automobile differing from the war motorcar in that it moves not on wheels but on two steel belts traveling on the heavy metal frames on either side of its diamond-shaped body. The belts consist of shoes ingeniously linked together in endless chains. Each shoe has a flange, with which the tank can lay a firm hold on the ground. The belts are fitted to heavy sprockets. The rear sprockets are connected by gearing with the powerful engine in the back of the tank. The front sprockets are idlers over which the belts glide. There are also wheels which rest on the upper surfaces of the belts. At the top of the frames are rollers over which the belts pass. The tank is really laying down twin tracks or a railroad of its own.

The body of the average caterpillar consists of thirteen segments, four of which belong to his thorax or, dropping into mechanical terms, his fore compartment, while nine are assigned to the abdominal section. The number of segments varies with the species. The chest portion has three pairs of true legs, so called because they are well jointed, easily controlled and muscular. They are protected with horny sheaths and are in effect armored. With these true legs the caterpillar can steer himself, help himself along a twig, or seize leaves.

The pro-legs, or false legs, appear on at least five of the segments, duly paired. In their structure they resemble the shoes of the tank belts to some extent and they perform the same functions. They are fleshy unjointed protuberances rather than limbs. At the bottom of each one are minute hooks which are used automatically in giving the animal a hold on the surface he is traversing. They are for clasping, and in fact the rear pair are so modified as to be called claspers. Now, if a caterpillar could keep his pro-legs or shoes moving over his head and over his tail in an endless chain arrangement, his resemblance to the tank as far as the locomotion details are concerned would be perfect.

Some of the caterpillars have such a rapid, undulating movement, that it is hard at first to analyze its elements. The caterpillar actually walks by extending and contracting the fleshy segments of his body, the power being transmitted mostly to his pro-legs.

Any one who has seen the fuzzy larvae of the tussock moth going up a tree trunk will realize that the caterpillar is happy at any angle. The same principle of construction illustrated in that insect permits the tank almost to stand on end without losing balance.

For the sake of simplicity, the wheels at the rear of the tank by which it was once steered have been discarded and the direction is given by running the two belts at different speeds. The landship is rudderless. The caterpillar can twist his segments at the jointures.

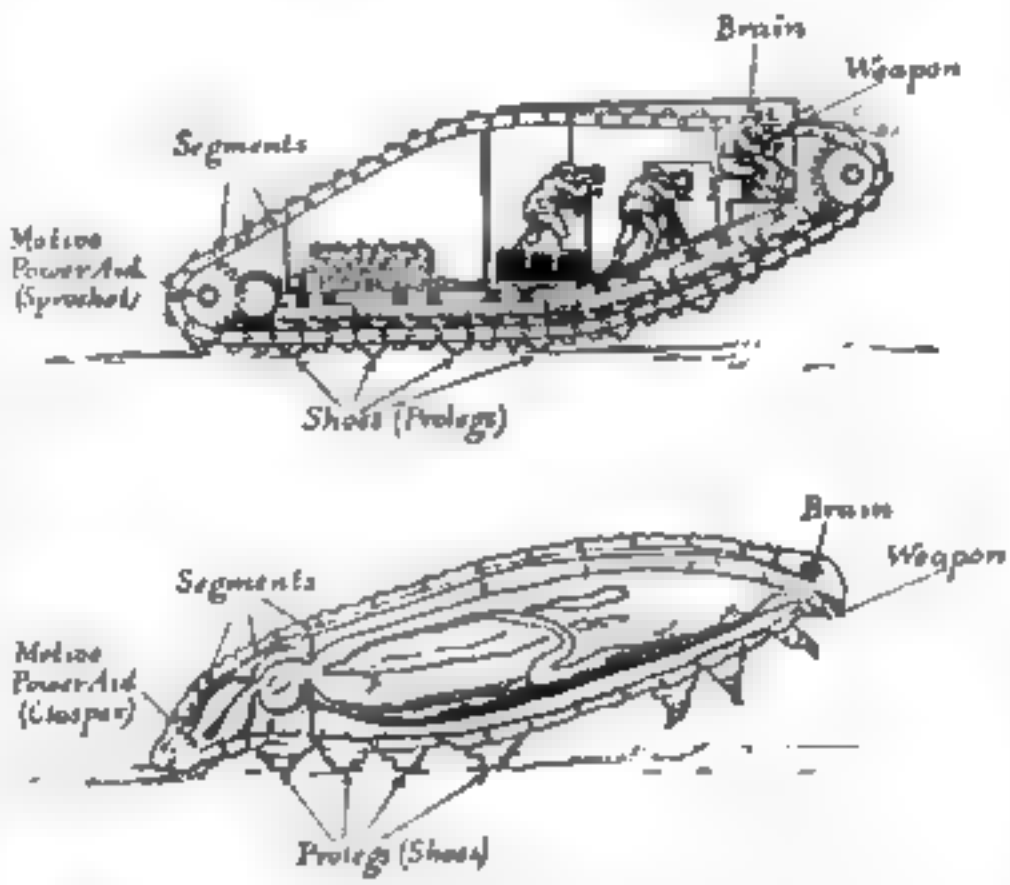
The observation facilities and guide centres of both are in their forward compartments. The commander of a tank and the driver sit well forward in the Juggernaut, looking out of very narrow

This comparison shows clearly the resemblance between a tank and a caterpillar. The artist has drawn them to such scale that they are both the same size and the immediate surroundings of each are in proportion. Suppose a caterpillar as big as a tank came marching over our fair country. Suppose he were eight feet wide and twenty feet long —the size of a tank—what a frightful monster he would be! Yet this is approximately the appearance of a tank to the Boches. No wonder that they cause such consternation

slits. When it is necessary to close the slits on account of rifle fire, the pilot gropes his way as best he may. The captain or lieutenant in command is the brains of the steel-clad caterpillar.

Caterpillars have fairly active brains and a good workable ganglia, or nerve center. On either side of the head they have small, shining eyes in rows. They also get good information about the nature of the surface over which they are passing by lowering delicate filaments or sense organs known as papilli.

The British tank is a terror to the Teuton infantry as it starts relentlessly over No Man's Land, crushing everything within its reach and mowing down the enemy. It brushes aside wire entanglements, shatters dugouts and forts of reinforced concrete and slays cowering wretches in the trenches whose cries for mercy the men in the car of death cannot hear. What the tank is to modern battle, the caterpillar may well be in the wars of the insect world.



A tank and a caterpillar are first cousins. Notice the wonderful likeness in mechanical detail

Imagine what a vision of frightfulness that hideous specimen of the larval state, the hickory-horned devil, would be to the human race, if he were enlarged to tank size, approximately eight feet wide and twenty-eight feet long! What a sight to make men's knees shake with fear, with his waving antennæ, his fierce and gleaming jaws, his towering horns, his beady eyes, and his ponderous bulk! He would ignore all obstacles as he went trampling and devouring over the plain, his vertical mouth opening and shutting meanwhile like a ponderous valve.

In the realm of twigs and leaves, the cry "The Caterpillars are coming!" must mean as much as the alarm "The Tanks! The Tanks!" means to the Germans. The caterpillar is not the inoffensive slug which he often seems to be as we look down upon him as he bestirs himself across some woodland walk. His hide is very thick, and underneath it is a heavy layer of fat. The doughty warrior ants coming out with their nippers to assail him, do not worry him much. Up goes the tank of the world underfoot, and down he comes with a swing of the forward part of his body and a group of his enemies are crushed to extinction. Several varieties of caterpillars have very effective weapons of offense. The species from which comes the swallow-tail butterfly mounts a rapid-fire poison-gas gun. When he is hard pressed by his enemies he will project from his head a tube which looks not unlike the barrel of a Lewis machine-gun, and discharge an odor so offensive that insects within scent of it curl up and die.

The camouflage of tanks and caterpillars is effective always. "Old Crusty" at the western front and "Old Crawly," of the garden both resort to disguise. The tank is often painted the hue of the mire; the caterpillar assumes the tone of the soil.

There scarcely seems a characteristic, therefore, either of the fuzzy denizens of the foliage or of the monster military mechanisms which may turn the tide of this war, which does not reveal that, after all, the terrors of the terrain are caterpillars titanic.

It seems, after all, as though "there's nothing new under the sun." We copy the fish for submarines, the birds for airplanes, and now the tank is just a glorified caterpillar.

How to Keep the Moisture in Cheese

CHEESE would not get stale and dry so quickly if proper care were taken of it as soon as it comes into the kitchen. If a whole cheese is bought at one time, after the first slice has been taken out of it, the flat side of a warm knife should be rubbed over the cut surface. This closes the pores and keeps the cheese moist.

Whenever possible, cheese should be wrapped in oiled or parchment paper. When such paper is not obtainable, cheesecloth which has been moistened in salt water and then wrung out almost dry, may be substituted.

It must not be kept too moist or it will go moldy.

© Int. Film Serv

These particular infants-in-arms are automobile foot-warmers used in a New York heatless street-car

"Stretching" a Pound of Butter to Make Two Pounds

TWO pounds of good table butter out of one pound and a pint of milk? Yes, it's done.

The churn which performs the feat was recently placed upon the market. It is square in shape and heavy of glass, and the churning mechanism, entirely of metal, is attached to the glass churn by a metal screw cap. In making the "stretched" butter the churn is warmed before the milk and shaved butter are put in. After stirring one minute the whole churn is placed into cold water and the operation is completed by churning for another minute. Salt and, if desired, some coloring should be added before churning.

Churn which makes one pound of butter into two pounds thereof

They Carried Stoves in Their Arms And Kept From Freezing

THEY sat huddled up together, four chorus-girls, in a freezingly cold New York street-car on one of the days that New York shivered and wondered whether it would ever be warm again. Each girl held in her hands what looked like an oval-shaped can wrapped in some fabric.

"What are they holding?"

Everybody in the car asked himself that question.

The mysterious cans proved to be automobile foot-warmers, heated by charcoal. Carrying a stove in your arms must have its pleasant side, judging from the expressions of the girls in our photograph. They would be awkward for shopping though.

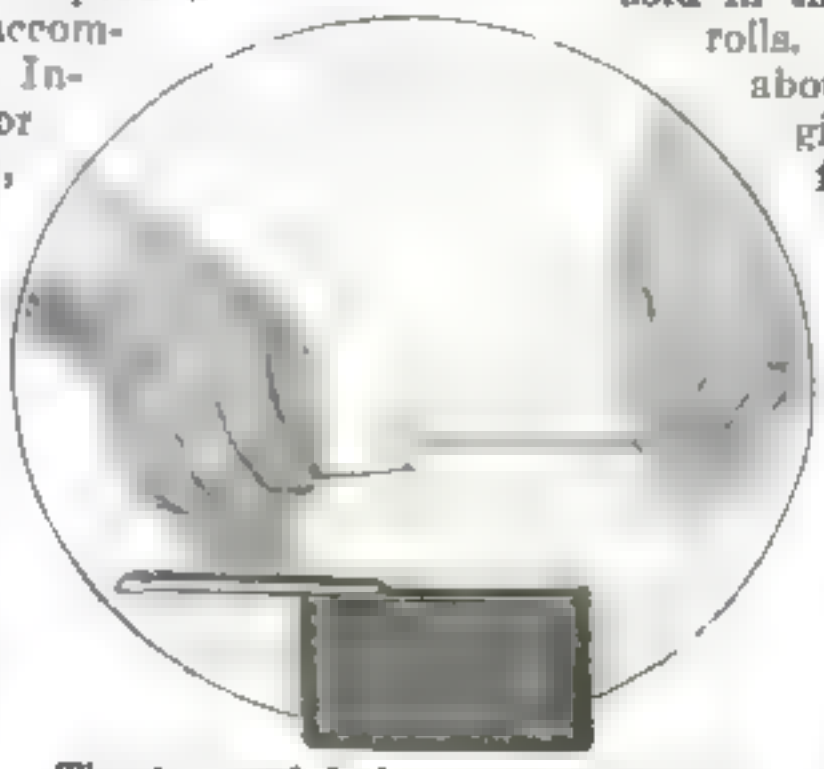
Our illustrations show monuments to the patriotism of the women of America and England. The lower one shows a collection of trinkets donated by English ladies, and the upper one by American ladies, to help the fight for democracy

ticles are taken to the United States Assay office and melted for the metal in them. The Government sends its check for the metal value of the trinkets to the fund. The money is to be used for the benefit of the American aviators and the welfare of their dependents in case of disaster.

In England the Duchess of Marlborough started a fund for Child Welfare, and many women, distinguished in society, contributed generously by donating some of their jewels to be sold for the benefit of the fund. The accompanying picture shows some of the most valuable jewels contributed. The hair ornament at the top, a rope of pearls and diamonds with thirteen clusters, was the gift of Lady Ward; the aquamarine and diamond corsage ornament in the case was contributed by Mrs. Cecil Baring; Lady Henry donated the turquoise matrix brooch surrounded by diamonds.

Trinkets and Jewels—Into the Melting Pot to Help Win the War

WHEN the aviation committee of the National Special Aid Society, decided to raise a fund for the benefit of the aviation branch of the American army, the chairman of the committee, Mrs. William A. Bartlett, adopted a novel method for accomplishing the purpose. Instead of appealing for cash contributions, the committee sent out a call for trinkets of valuable metal. The response was immediate. Our picture shows Mrs. Bartlett sorting over a box full of mugs, vases, teapots, brushes and other articles of silver, which had been sent to the committee by patriotic women. These ar-



The stove and fuel here illustrated will radiate heat continuously for three hours

Carry a Stove in Your Pocket and Keep Warm

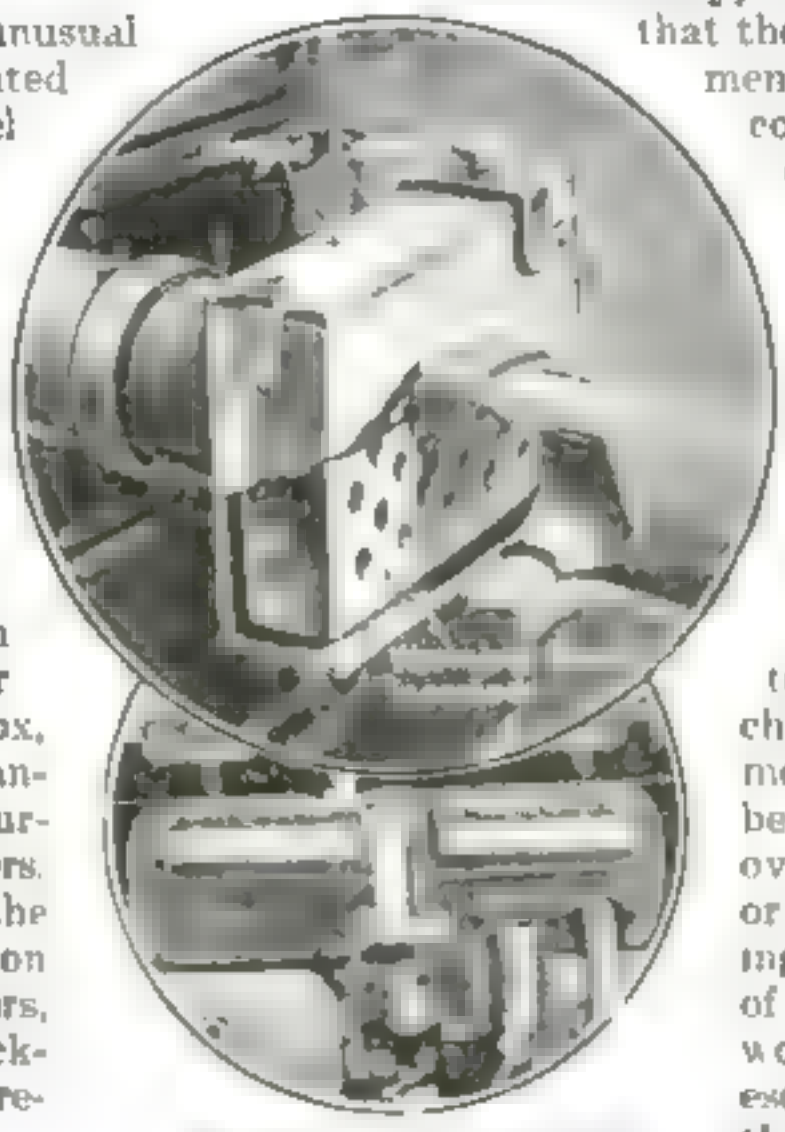
THE Japanese pocket stove has made its way around the world. It consists merely of a metal box with a sliding lid, and covered with cloth. The unique feature of the stove is the fuel, which is sold in the form of sausagelike rolls. These will burn for about three hours without giving off any smoke or fumes.

The fuel consists of vegetable materials, converted into charcoal, mixed with saltpeter, and pressed into cylindrical form. These are dried in the sun and then wrapped and packed.

This kind of stove was extensively used by the Japanese soldiers in the Russo-Japanese war.

Starting the Kerosene Car from the Kitchen Range

ONE of the most unusual devices yet invented for heating kerosene fuel when an automobile using such fuel is to be started, consists of a rectangular metal block with holes punched through it. This is heated by being placed for a few minutes over the kitchen gas range, or coal stove, and then inserted in a similar sized rectangular box, placed in the intake manifold, between the carburetor and the cylinders. When starting the car, the kerosene fuel is heated on its way to the cylinders, so that it vaporizes quickly. The block is not removed until again required.

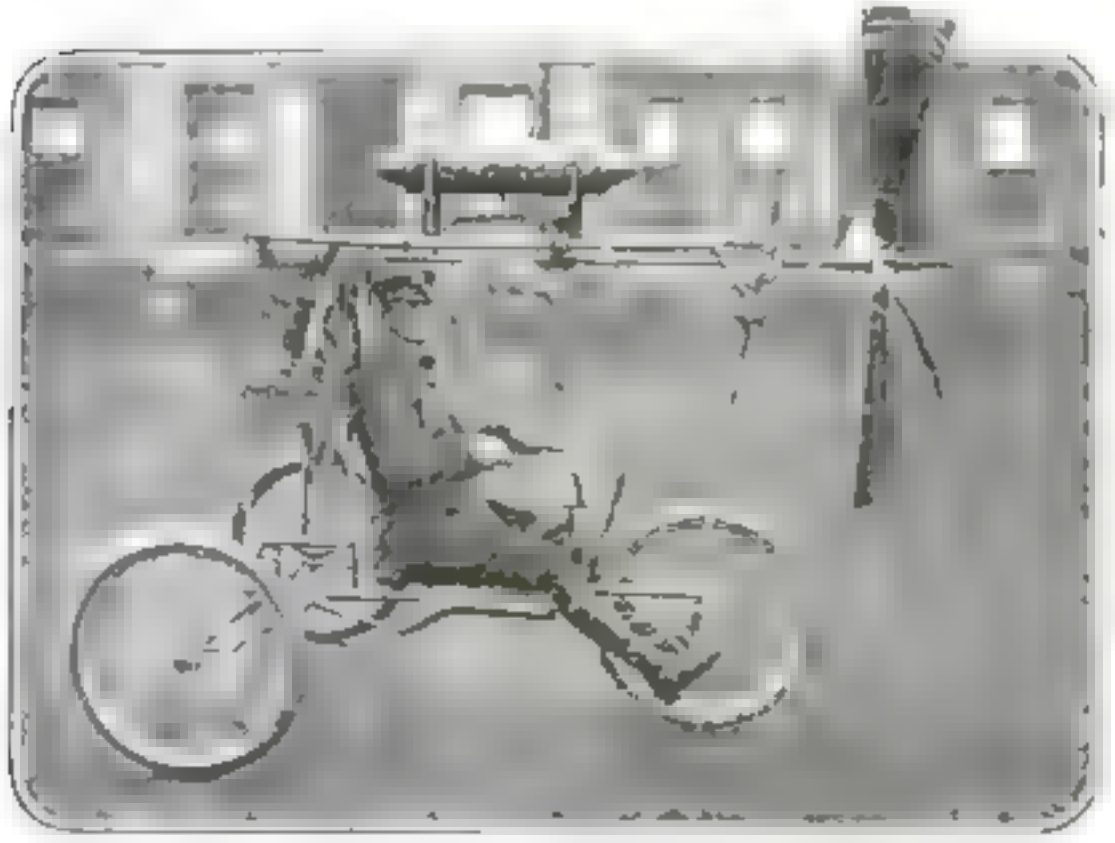


The metal block is first heated against the stove

The Aerautomotricycle — a Weird Machine Made by a Doctor

FOR a cool spin on a hot afternoon, the vehicle shown herewith has conspicuous merits. The propeller in front secures an effective and bracing air bath for the driver.

Mechanically, this vehicle demonstrates that the three well known elements, a tricycle, an air-cooled "V" motorcycle engine and a propeller can be combined, and how showy the combination can be made. The gasoline tank at the top, with its pointed ends to pierce the atmosphere, suggests great speed. If the propeller were at the rear, close to the engine, the machine would look common, as there would then be no need of the long overhead frame of tubes or the complicated steering, and much vibration of the propeller shaft would be suppressed and escape notice. Actually, the propeller blades are made of thin sheet metal for lightness, and therefore have to be braced with guy wires. This type of blade—the same as that used for the cooling fans of automobiles—consumes much more power than it returns in propulsion. By virtue of this property, which under other circumstances might be termed a defect, it tends to keep the engine busy and quiet even at the very moderate speeds for which the vehicle seems best suited. There are no springs or other means for moderating road shocks and vibration of the whole structure. As it appears in the photograph the machine is harmless, the chain being removed from the large sprocket wheel on the drive shaft, but it gives an excellent idea of its appearance as it runs around the city streets and avenues. The machine has given its owner much pleasure and amusement, both in its building and running.



Tricycle with engine-and-propeller mechanism built by an enterprising and ingenious physician of New York City

Dealing Death with Depth-Bombs

How depth-bombs and new sea tactics are foiling the submarines

By Lloyd E. Darling

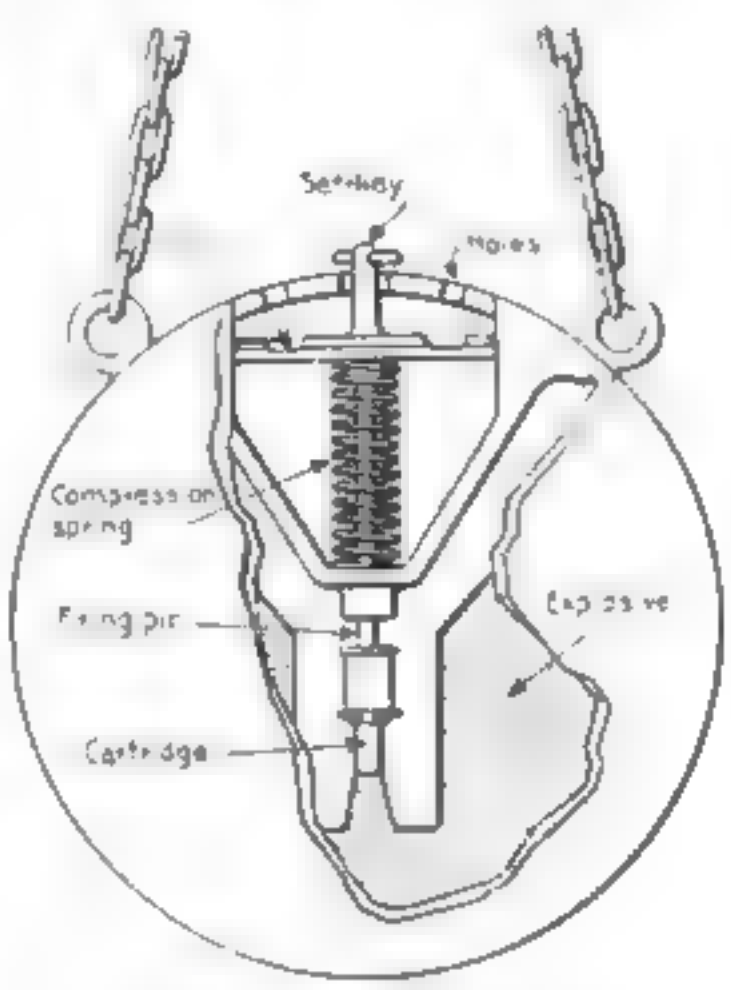
WHAT is the reason submarines have occupied less and less of the limelight recently? How does it happen that their ferocity has proven not so unconquerable as at first thought?

It's a good old American reason—pluck and inventive genius.

We should announce at the beginning that the tactics of American destroyers operating in the submarine zone are just the opposite of what has been current practice. Every time our destroyers see a submarine, they head straight for it. The old idea was to circle around and take pot shots every time opportunity offered. The new idea works havoc with the plans of underwater plotters.

But suppose our destroyers do head straight for the submarines—how do they do any exterminating even then? Answer: Depth-bombs.

Let us pause for a moment and consider how two American destroyers, the *Fanning* and the *Nicholson*, recently disposed of a U-boat with depth-bombs. The incident, as variously reported in the Associated Press despatches, was exciting. We may retell it as follows:



Depth-bomb mentioned by E. F. Chandler. Water enters through holes, pushes dial or diaphragm. Spring, regulated by set-key, opposes the pressure. At proper depth pressure causes explosion

Wherein One Submarine Succumbs

"Periscope two points off the starboard bow!" called a lookout on the *Fanning*. Instantly an alarm to general headquarters was sounded and the helm thrown hard over. Signal flags were swung out, notifying the sister ship of the exact location of the enemy. At the same time the heliograph began its staccato flashing of orders for a combined attack.

The submarine submerged. Straight for the spot where last it was seen went the *Fanning*. Arriving, the commander re-

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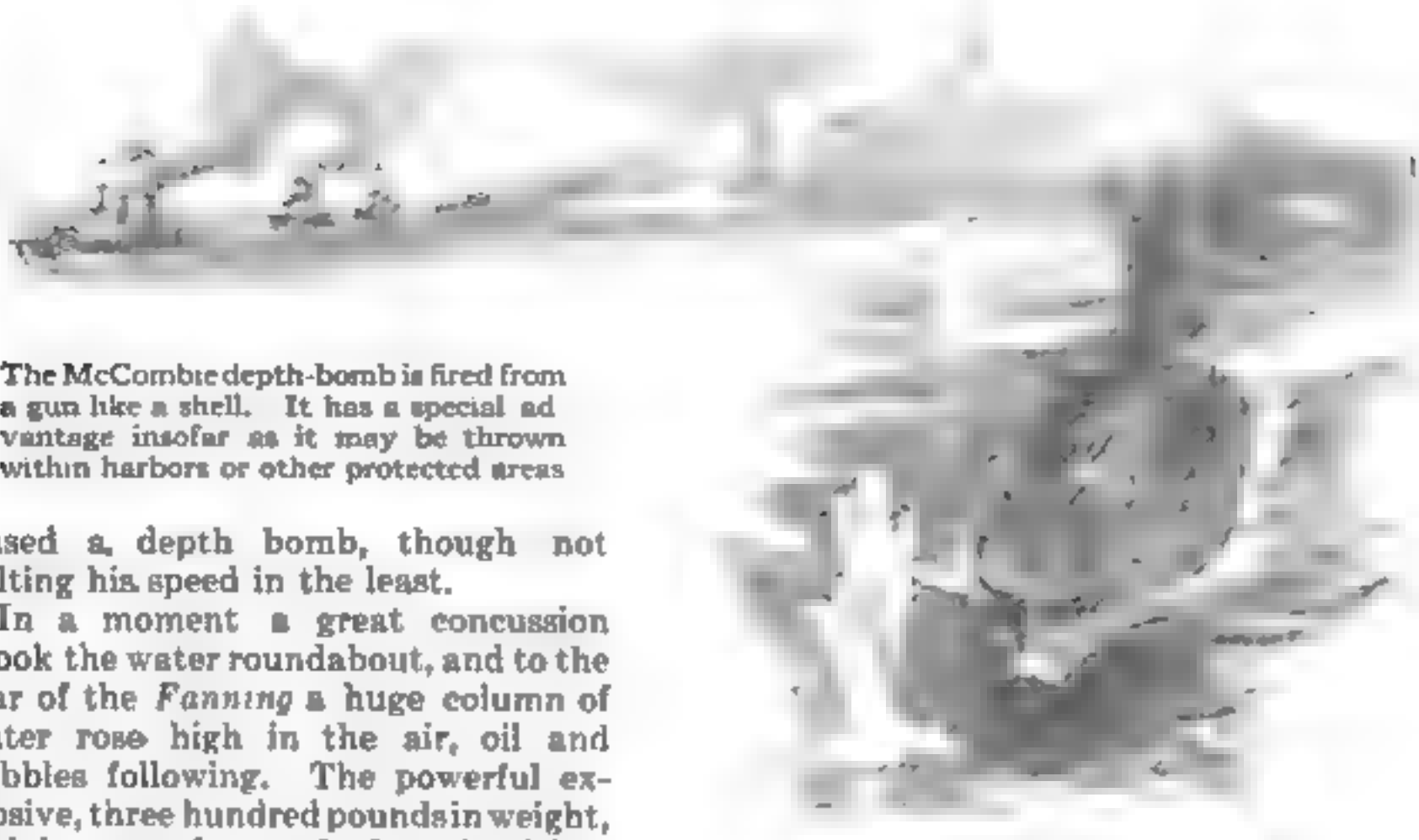
Submarine sinking for the last time. *Fanning's* gun at left means business

Crew of submarine surrendering to United States destroyers *Fanning* and *Nicholson*



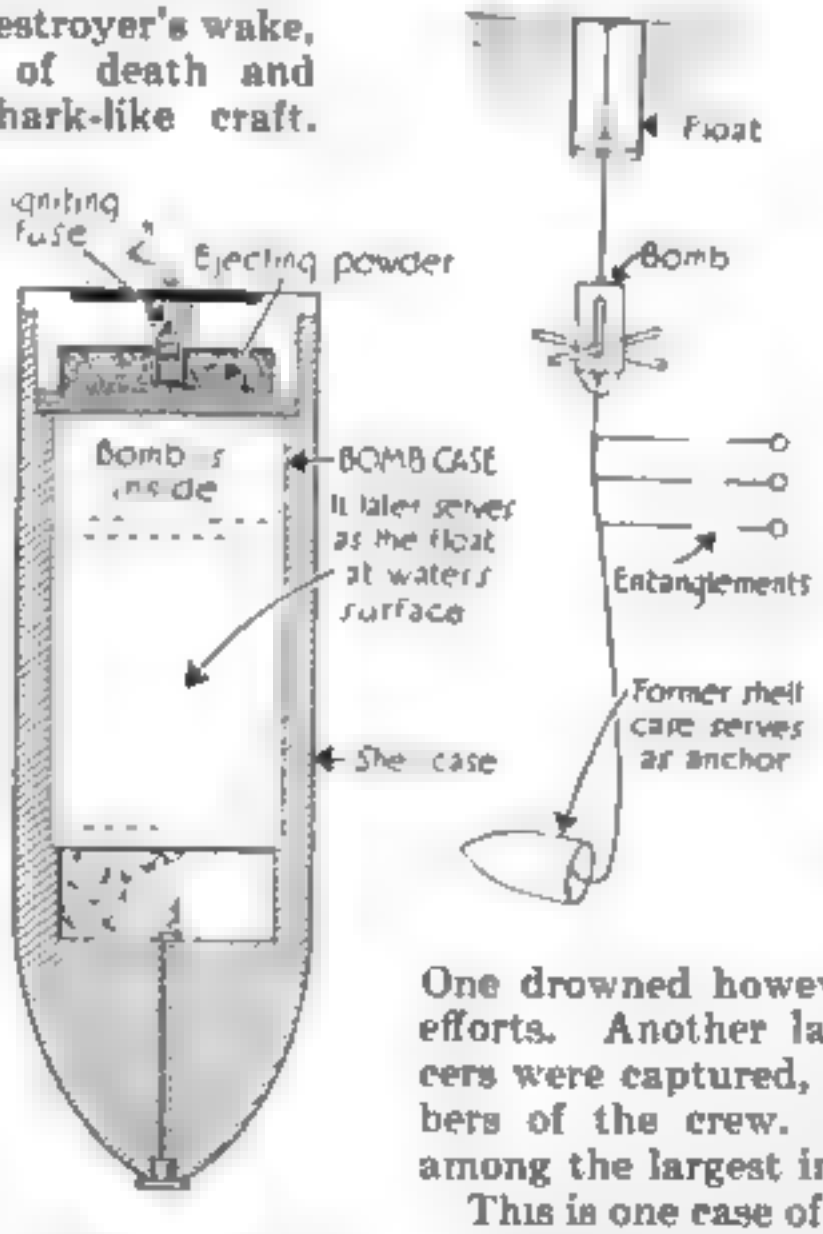
The McCombie depth-bomb is fired from a gun like a shell. It has a special advantage insofar as it may be thrown within harbors or other protected areas

leased a depth bomb, though not halting his speed in the least.

In a moment a great concussion shook the water roundabout, and to the rear of the *Fanning* a huge column of water rose high in the air, oil and bubbles following. The powerful explosive, three hundred pounds in weight, and in a steel case, had sunk with a little splash into the destroyer's wake, bringing its message of death and destruction to the shark-like craft.

Meanwhile the *Nicholson* had arrived on the scene, and it too dropped a depth-bomb. Then both boats began circling the area waiting developments.

Inside three minutes developments came. With a splash of water the submarine suddenly appeared on the surface, like a great whale coming up to breathe. It behaved erratically; was evidently unmanageable. The *Fanning* again bore down, firing from the bow gun. The *Nicholson* also closed in. But only a few shots were necessary. Out piled the entire German crew, holding up their hands in token of surrender. Before they could all be transferred the U-boat sank from under them, never to return. Some of the American crew jumped into the water in an attempt to save stragglers.



Upon the McCombie bomb's alighting in the water, a water ignited fuse sets off ejecting powder. Thereupon bomb separates into three parts, a float, the bomb, and outer shell-case itself

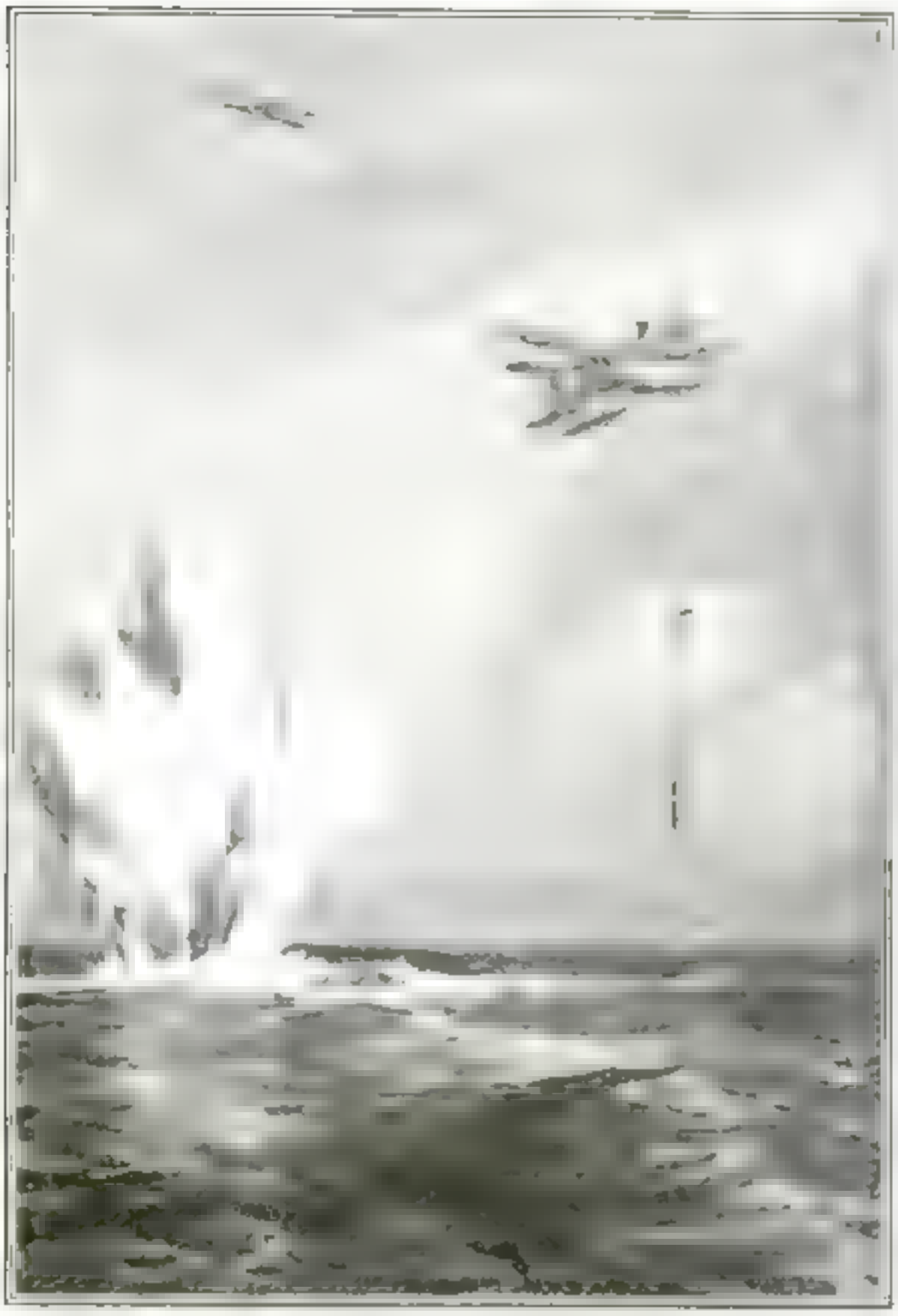
At center of page is bomb before separating into its three parts. Parts after separation are at left. Entanglements catch on passing ship, draw bomb against its side, projecting glass tubes containing fuse-mechanism break, and bomb explodes

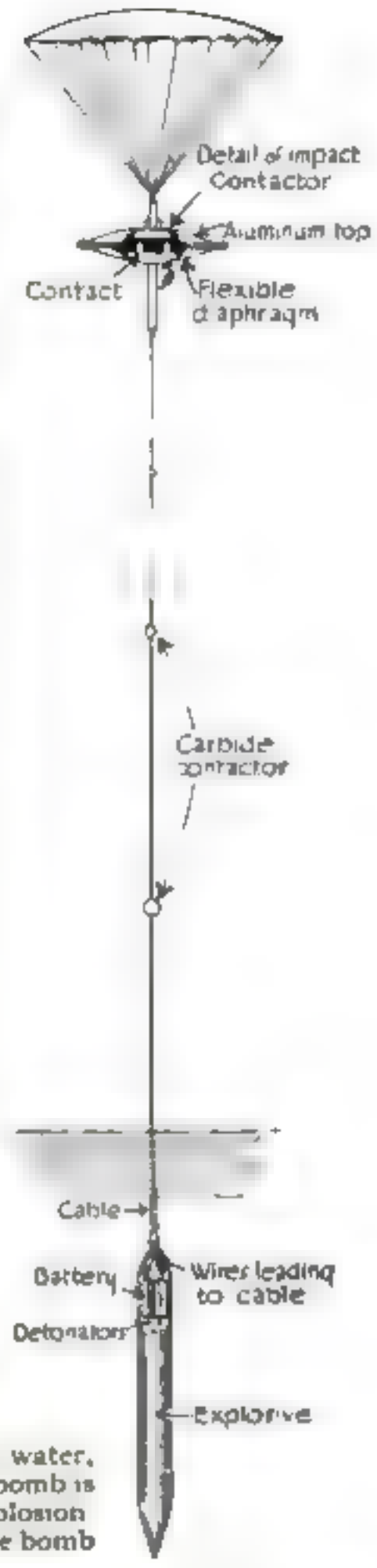
One drowned however, in spite of these efforts. Another later died. Four officers were captured, and thirty-five members of the crew. The submarine was among the largest in the Germany navy.

This is one case of effective work on the part of depth-bombs, and of American sea strategy. It is typical.

Depth-Bombs Are of Many Kinds

What are depth-bombs? Trinitrotoluol or other high explosive in a container. Detonated under water, they cause a





Hallock parachute depth bomb Flexible diaphragm, upon striking water, closes a pair of contacts. Circuit through the electric cable leading to bomb is thus closed bomb explodes. Length of cable determines depth of explosion If the diaphragm contactor fails to work, carbide contactors set off the bomb

violent compressive wave to go out, caving in the side of a submarine in the vicinity as if it were an eggshell.

According to Edward F. Chandler, a New York expert on underwater developments, one type of effective depth-bomb depends solely on water pressure for explosion. The illustration on the right shows details.

The bomb may be of any convenient exterior shape, and is customarily equipped with two eyes for the attachment of supporting chains at the stern of a destroyer, or other convenient point. The underwater pressure acts simply. Pushing in on the diaphragm shown, it causes a detonator to be fired and the explosive set off. The particular depth at which detonation occurs may previously be fixed by adjusting the bolt which projects through the diaphragm and outer shell of the bomb. A graduated scale reading in feet makes this easy. The bolt tightens up or slackens the coil-spring pushing on the underside of the diaphragm, thereby making a correspondingly greater or lesser water pressure necessary to compress it and produce an explosion.

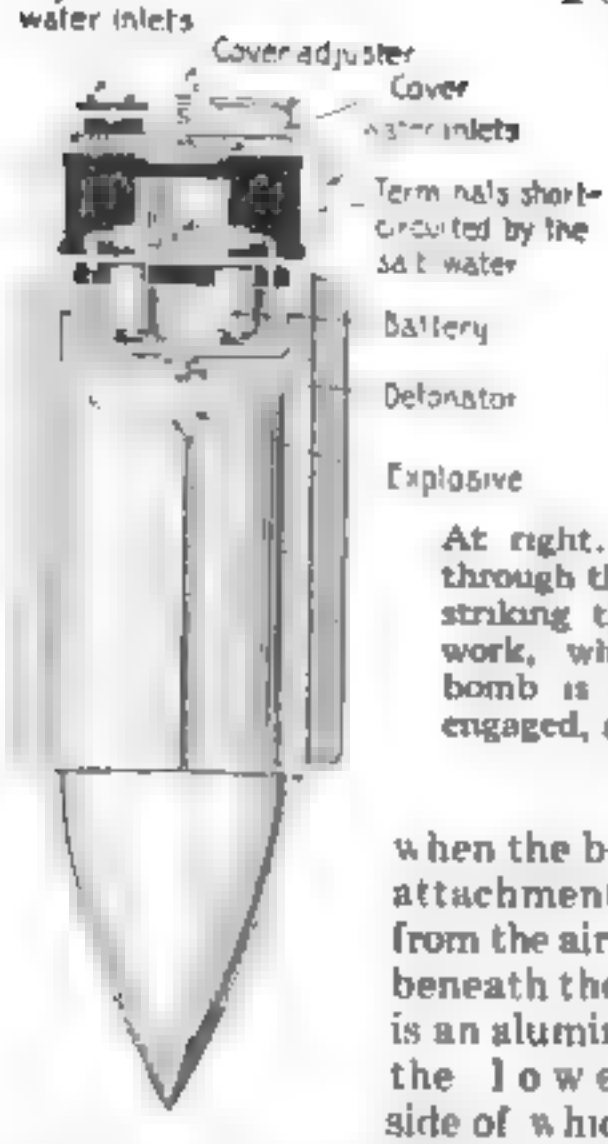
Evidently the type described by Mr. Chandler is the result of evolution, and it

probably is the most effective yet developed. However, many other kinds have been patented. A Virginia man named Dunlop produced the one depicted on page 566. This is exploded through the driving in of a pair of wings upon the bomb's striking the water. These wings release a suitable clockwork, which must run a short time before the primer is set off. Meanwhile the bomb is supposed to be sinking as a result of its initial velocity in striking the water. Whether or not it would always do this, and whether the complicated clock mechanism would always run properly is open to doubt. But obviously a clockwork is one way of exploding a depth-bomb and probably many working on the general principle are in current use. None of the Allied governments will tell precise details of the latest developments in depth-bombs, for the Germans would be too interested. But from a consideration of general types already known in the depth-bomb field, an idea of the underlying and fundamental principles may be obtained.

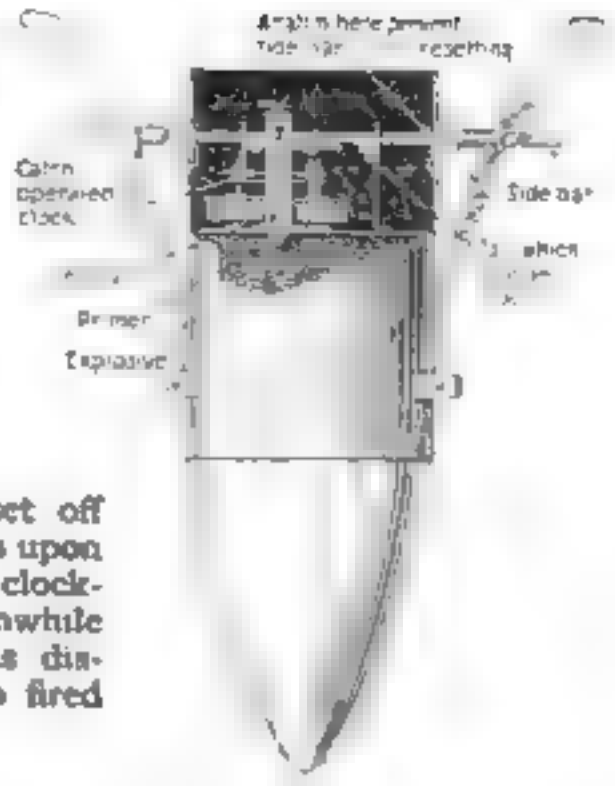
Airplanes Use Depth-Bomb

Not all depth-bombs are dropped by destroyers. Airplanes have used them with great success. On page 564 we show a type produced by W. J. Hallock of Jersey City. The explosive is contained within a long, pointed cylinder at the upper end of which is a detonator and a small electric battery. An insulated electric cable containing two wires is attached to the upper part of the cylinder, and leads to a relatively small parachute which serves to straighten out the cable

How an airplane "gets" a submarine. A depth-bomb causes a tremendous explosion caving in a submarine anywhere in the vicinity. No wonder German submarine crews mutiny!



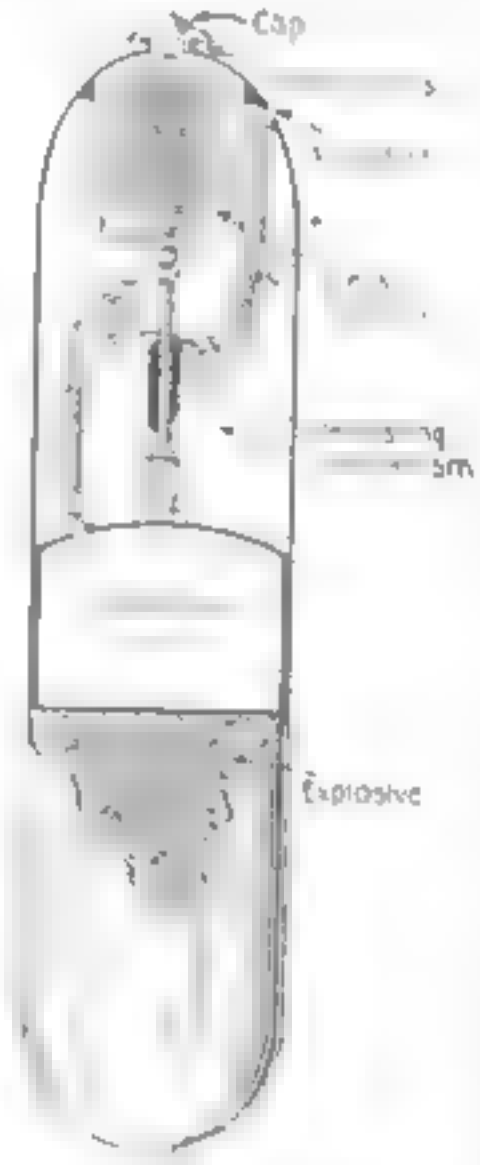
At left: Another Hallock depth-bomb. This one explodes through the action of salt water entering through the sides and top of the upper end and short-circuiting a pair of terminals. Depth of explosion is regulated by adjusting the openings at which the water enters



At right. Dunlop bomb, which is set off through the driving in of a pair of wings upon striking the water. Wings release a clockwork, which runs for a time (meanwhile bomb is sinking), then a firing-pin is disengaged, a primer set off, and the bomb fired

when the bomb and its attachments descend from the airplane. Just beneath the parachute is an aluminum disk on the lower side of which is mounted a flexible diaphragm. When the diaphragm strikes the water in trailing along after the bomb at the end of the cable, it is driven inward, and causes an electric contact to be made between the ends of the wires coming up through the cable, which, in turn, causes the bomb's explosion at a depth below the surface determined by the cable's length. Should this impact contactor at the diaphragm fail to set off the bomb, other pairs of contacts are provided at intervals along the cable's length. These are separated by pieces of calcium carbide, or starch, and are suitably protected from mechanical injury. The carbide or starch dissolves, allowing the contacts to come together and explode the bomb.

Another of Mr. Hallock's inventions is shown above. This one is without a parachute and explodes by the action of salt water entering at the sides and top of the upper end, and completing an electric circuit through the pair of electrodes shown. The depth at which the bomb is to explode is regulated by adjusting the size of the openings admitting water. The smaller the opening the longer the bomb can descend as a result of its initial velocity before flying into atoms.



The Leon depth-bomb—one type. U. S. Government has experimented with these considerably during past year. Here regulating mechanism for keeping bomb at a pre-determined depth is shown. Pressure of water actuates a bellows. This opens and closes a compressed air supply just enough to keep bomb at depth desired. Firing mechanism not shown

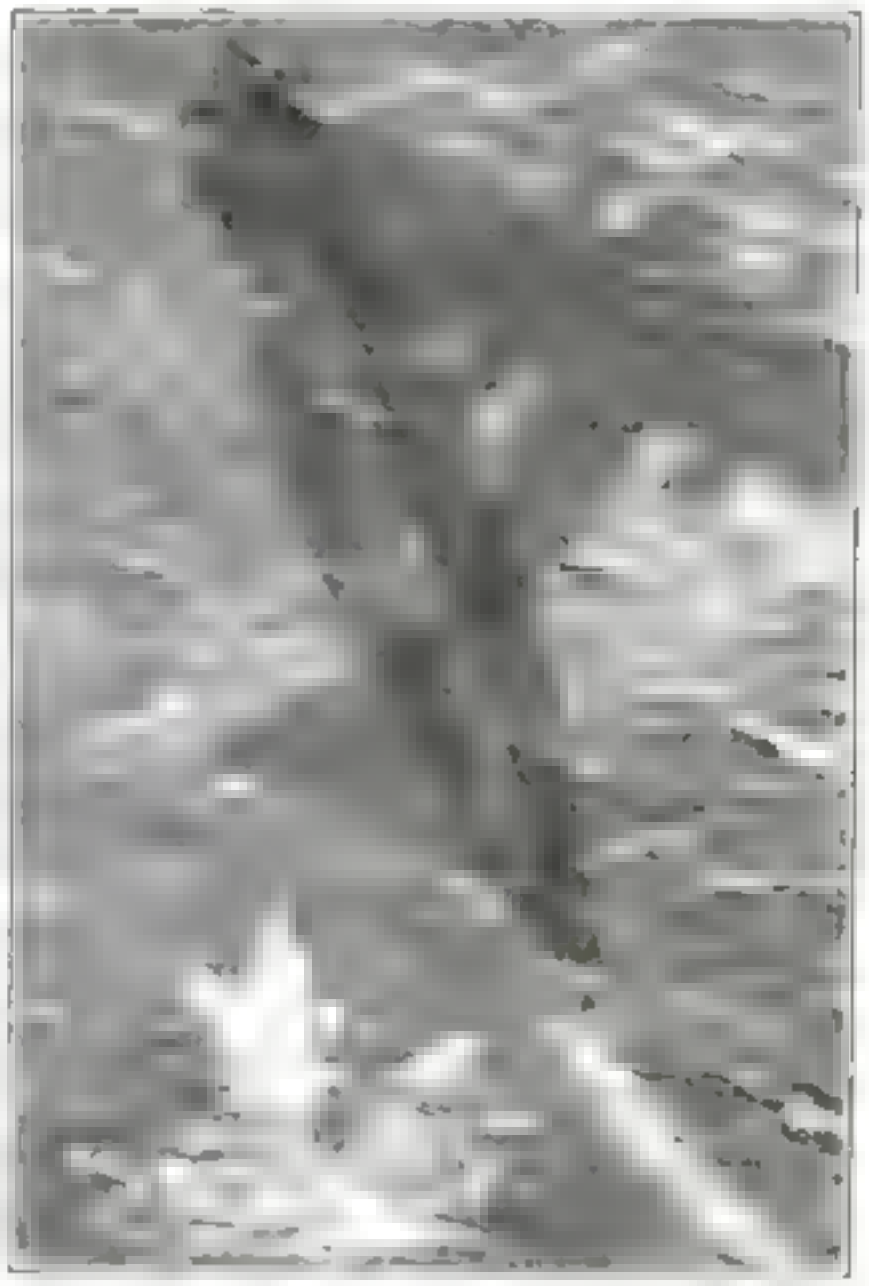
It is a curious fact, discovered since the war began, that an airplane when high in the air, can frequently see a submarine plainly, even though it be submerged as much as one hundred feet. Naturally the depth varies with the clearness of the water in any given region, but surprising results have been attained. A submarine is visible under water from a height for the same reason that a nickel is visible in a pan of water when your eye is directly over it. Should you get your eye off to one side and almost to the level of the water in the pan, refraction (light-bending) effects would enter in, as well as reflection of other objects to your eye from the water's surface. In consequence you could not see the nickel. It is for the same reason that one can rarely see the bulk of a submarine under water from the deck of a

ship, though it may be perfectly visible from an airplane. The man on the deck can see only reflections from the choppy waves. He is too near the surface.

K. O. Leon, a Swede, has patented in this country an unusual depth-bomb mechanism. The sketch on page 566 gives details. The Government has experimented extensively with this type and its variations. The peculiar feature about this machine is that it is designed to keep a depth-bomb at a certain predetermined depth beneath the surface, to remain there until contact with an underwater prowler sets it off. A metal bellows at the top of the bomb is filled with air and is surrounded by seawater which enters through the topmost point of the bomb's case. Naturally, the pressure which this water is capable of exerting varies with the distance the bomb happens to be beneath the surface. Mr. Leon has not disclosed in his patent the particular type of firing mechanism he uses with his bomb.

T. G. Fitz G. McCombie has invented a type of depth-bomb to be fired from a gun. The bomb can thus be dropped among enemy ships with the readiness of a shell, yet possesses the submerged exploding feature so destructive to a ship's plates beneath the water line. The figure on page 563 shows details.

All reports from the zones where submarines are operating indicate that depth-bombs are almost the universal means of going after and "getting" underwater prowlers. While other means for exterminating U-boats will be evolved during the war, few can be so simple and effective.



How a submarine under water looks to an airplane above. It makes a fine depth-bomb target

The War Hath Slain Its Millions, but the Nursery Its Ten-Millions

WHO is the safer, a soldier in a Flanders trench, or a baby in an American cradle? Statistics would seem to show that the soldier has much the better chance of living to a green old age.

The statement recently made by Secretary of War Baker, and the statistics published by the Prudential Insurance Company of England, both agree that the mortality among the men at the front is just about twenty out of a thousand—two per cent. On the other hand the death-rate among babies, before they reach their first birthday, is one hundred and forty out of a thousand—fourteen per cent. It will thus be seen that a soldier has a sevenfold better chance of living than a baby.

The worst part is that all this baby-killing is due to ignorance and negligence. Improper foods and clothing, and the criminal ignorance of both midwives and mothers are the underlying causes. Food is one of the things about which the greatest ignorance is displayed. Conditions can be imagined when a certain city found it desirable to print notices saying "Beer and Pickles are Bad for Babies!"

It is estimated that at least fifty per cent of infant deaths are preventable, proved by the fact that in other countries the death-rate for the first year of life has been cut to half that of the United States and that certain cities in the United States have cut their infant death-rate to less than half the average for the country at large.

The mechanical cashier. This machine collects, sorts, and counts various coins

It Eats Nickels and Dimes and Counts 'Em Too at the Same Time

A NEW fare register is being used at subway stations and various other places. It does away with the selling of tickets.

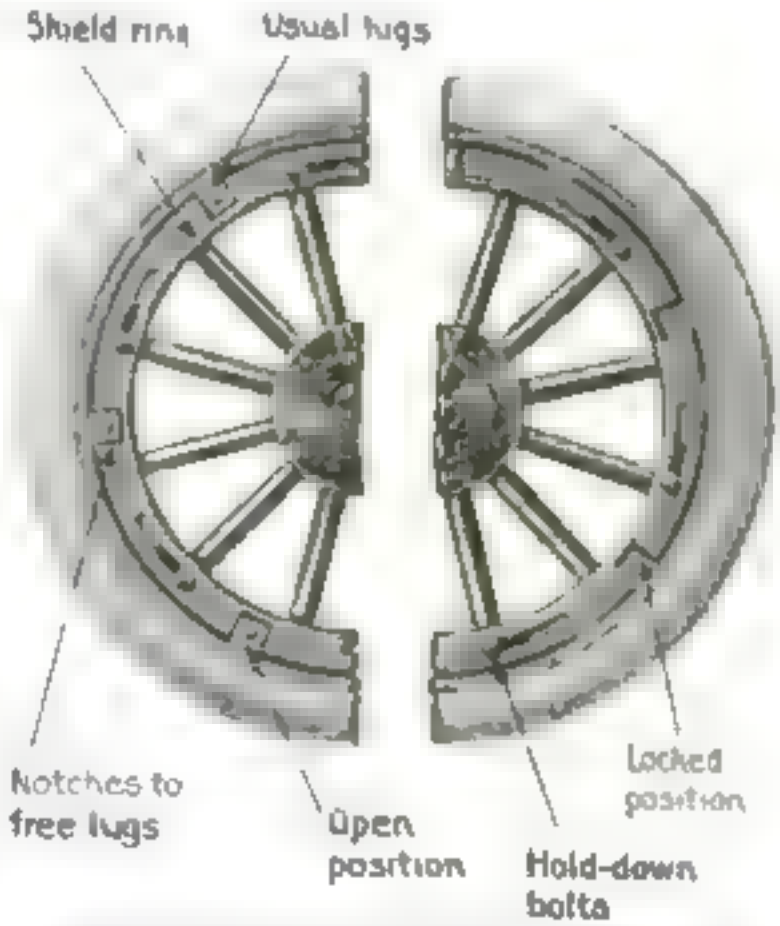
The passenger drops his coin into the hopper. It passes on to a revolving drum, and then to a revolving pan having three holes in it. Any penny, nickel, or dime is brought by this pan to the counting table. Coins of larger denomination cannot get into the machine. At the counting table a sorter gear rotates a cam on which are three projections adapted respectively to catch the pennies, nickels, and dimes. These then register and total up, an indicator at the top of a short column at the upper part of the machine showing the total number of fares paid to date and also the amount in the register in dollars and cents.

If a man has a nickel he can drop it in the hopper and immediately pass to his train without losing time buying tickets.

Loosening all the Lugs of a Demountable Rim at Once

IF you own an automobile you know just what it means to have a tire puncture. You have to unbolt each clamping lug in order to remove the rim and then adjust and tighten each into position when the rim is replaced. If you have six bolts to unscrew and then tighten, each one takes you about two minutes—a total of twelve minutes. What a saving and a blessing it would be if all the clamping lugs could be released at once and clamped back into position at once.

Mr. R. G. Mason, a Brooklyn inventor, has made this possible and thus you can change your tire in almost no time at all. He mounts a heavy locking ring outside or in front of the clamping lugs on the side of the wheel felly. This ring has openings corresponding with the lugs, and by moving the ring the detachable part of the rim can be taken off and put on in one operation. Turn the ring until the openings are opposite the lugs; the rim can be removed because the lugs are loosened. Now when the lugs are to be readjusted and locked into position, the ring is shifted again until the solid portions of it are opposite the lugs. The illustration shows the details.

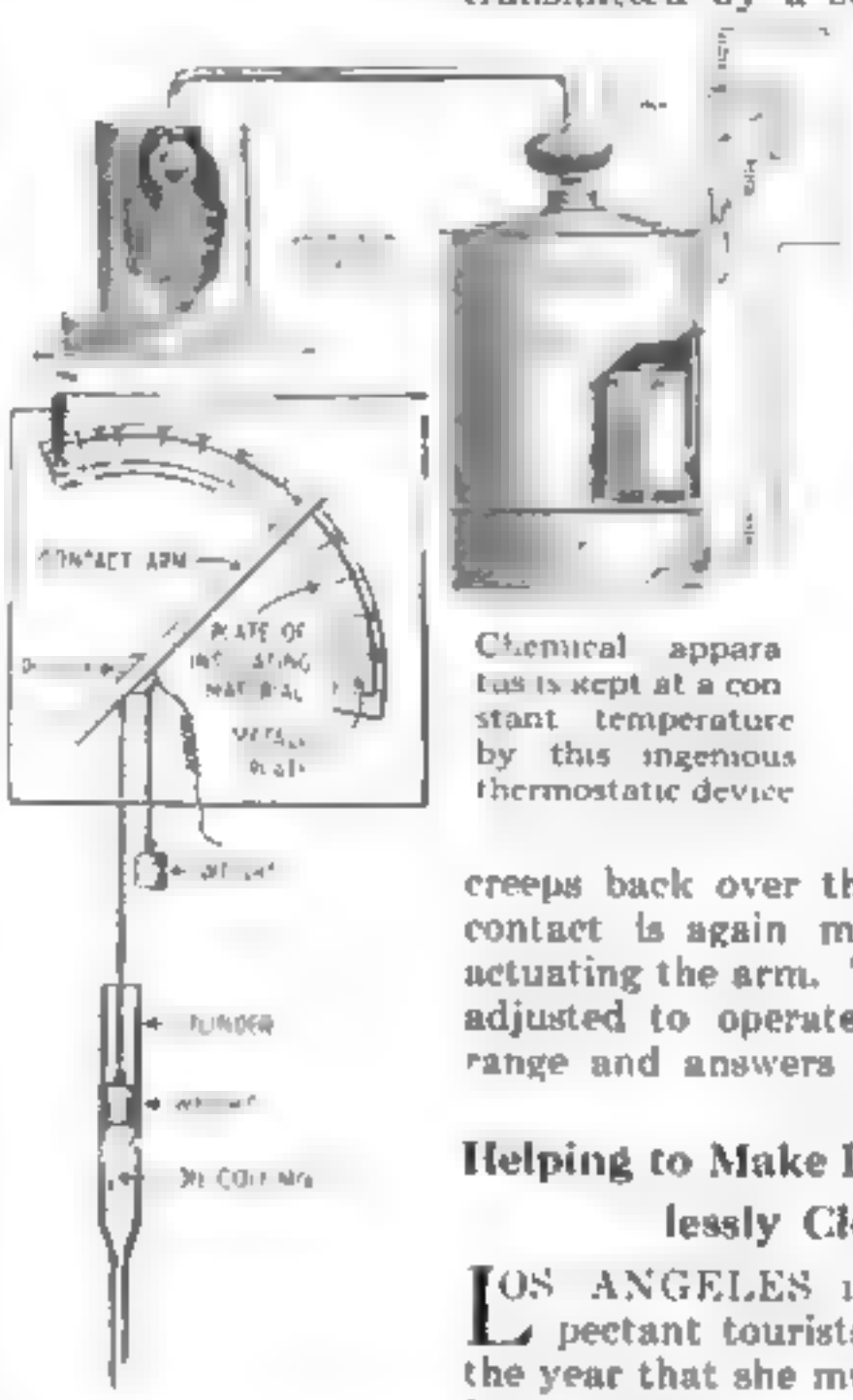


This device pares down the minutes and the trouble in tire-changing operations

This Regulator Will Keep Your Apparatus at a Constant Temperature

IN fractional distillation and other chemical operations it is often necessary to keep the material which is being used at a constant temperature for many hours, or even days. This is particularly difficult when electricity is used as the source of heat.

Mr. Louis Velasco, of Wilmington, Del., has invented an improvement for automatic thermal cutouts for electric circuits which is adapted for use in connection with heating apparatus. After the heat has reached a predetermined degree the current is shut off until the temperature falls to a given point, when the current is again switched on and the temperature again rises.



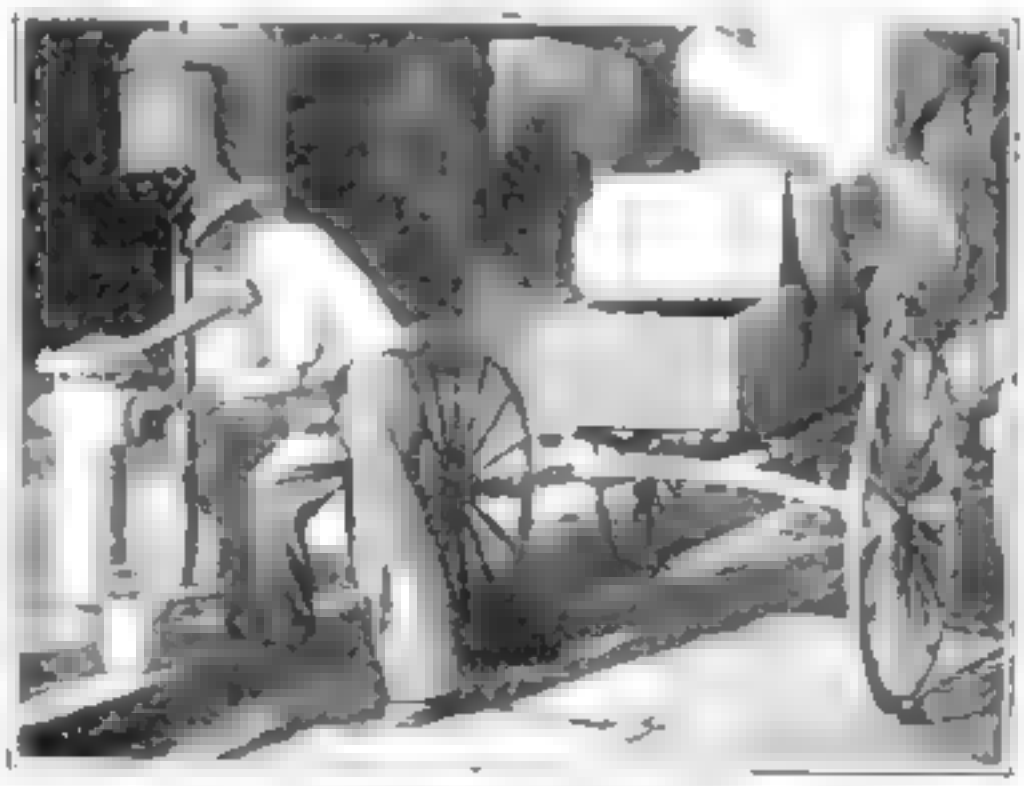
Chemical apparatus is kept at a constant temperature by this ingenious thermostatic device

A receptacle containing air, or other gas, communicates by means of a small diameter tube with a glass U-tube containing oil, on the outside of the evaporator. As the temperature rises, the expansion of the air in the container forces the oil around the U-tube and raises a weight which rests on the surface of the oil. This motion is transmitted by a string to a pulley, to which is affixed a contact-arm which makes contact on an arc-shaped piece of metal. As the temperature continues to rise the arm is moved over the metal plate until at length it passes beyond it and so cuts off the current. When the temperature falls again, the gas in the container, following Charles' Law of Temperatures, contracts and the contact arm creeps back over the plate until at last contact is again made, the weight now actuating the arm. The apparatus can be adjusted to operate over a considerable range and answers its purpose very well.

Helping to Make Los Angeles a Spotlessly Clean Town

LOS ANGELES is on display to expectant tourists so many months of the year that she must always be dressed for company.

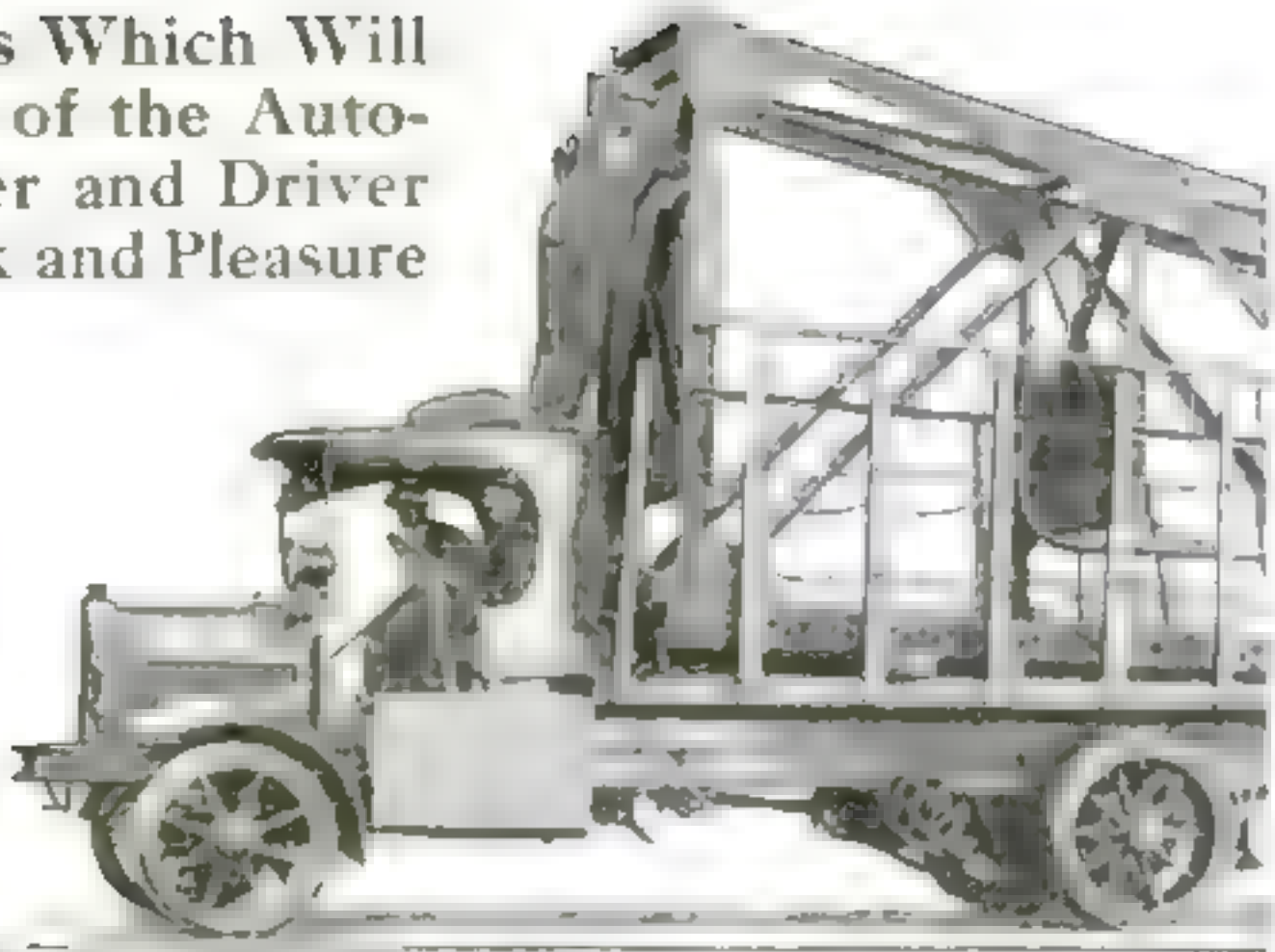
One man is employed exclusively to paint the water hydrants. This single little item in keeping the city well groomed requires, besides the services of a painter, a specially built buggy in which the necessary equipment is carried in a neat box behind the seat.



The painter's equipment is carried in a neat box behind driver's seat of this specially built buggy

It is carried on under the direction of the local fire department.

Conveniences Which Will Ease the Lot of the Automobile Owner and Driver in Both Work and Pleasure



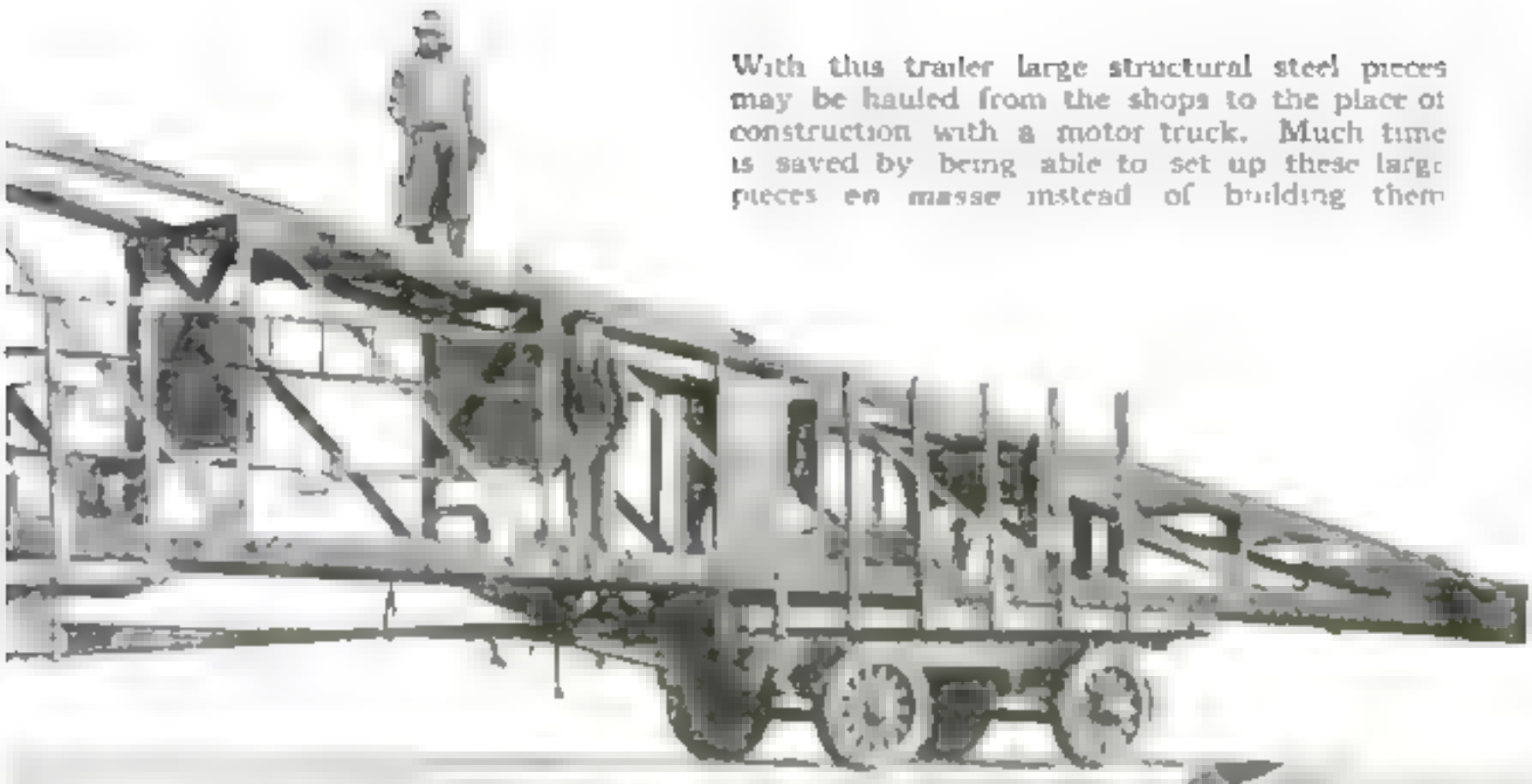
Motor truck with capstan [illegible] by the motor which is used for [illegible]

A radiator cap [illegible] with that [illegible] as long as the water is circulating properly

An easily constructed tire stand for making the work of tire repairs less tedious. Note the handy tool box and the solid construction

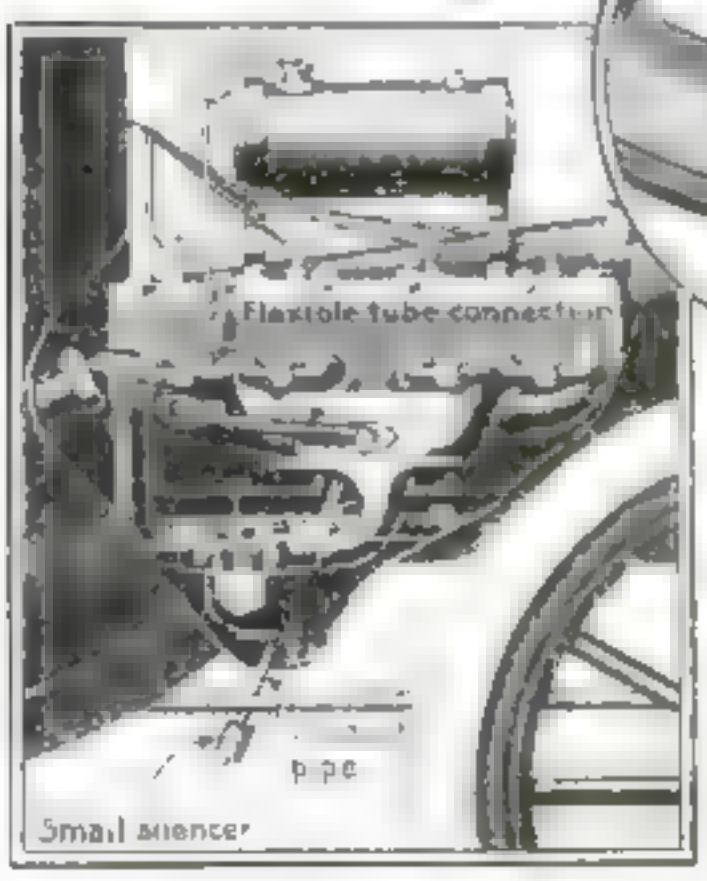
A [illegible] radiator cap for returning condensed steam to car radiators

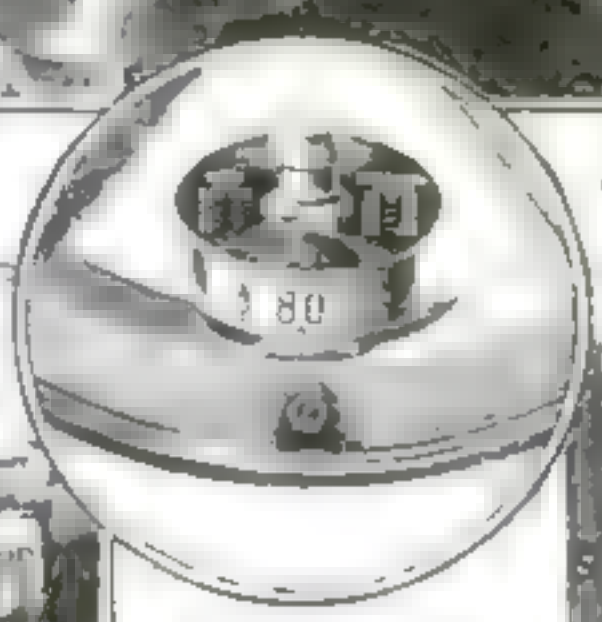
A folding bed for the auto- [illegible] may be used with [illegible] The very thing for the outdoor man



With this trailer large structural steel pieces may be hauled from the shops to the place of construction with a motor truck. Much time is saved by being able to set up these large pieces *en masse* instead of building them

The ordinary farm buggy obeying the law with a real acetylene h

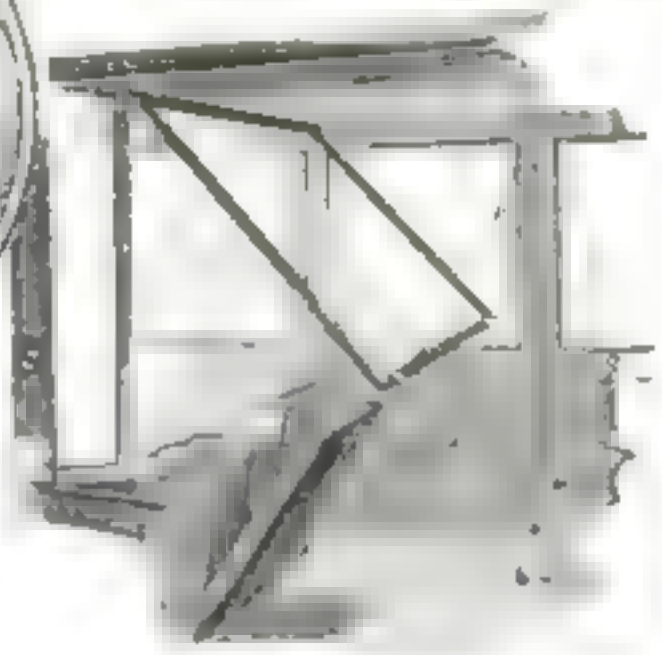




A tire gage attached to the valve stem Driver can see pressure any time

At left: Kerosene vaporizer within the inlet manifold, heated by the exhaust

The body of this coal truck is mounted on a turntable revolved by hand



Swinging partition and drop center back change limousine into sedan whenever desired

Conquering the Poles by Airplane

Shall we be able to skim to the north pole by airplane? Read Admiral Peary's prediction

"IN the very near future," says Rear-Admiral Robert E. Peary in a new book, "Secrets of Polar Travel" (Century Company), "the biting air above both the earth's poles will be stirred by whirring airplane propellers. The last three years of war abroad have advanced the development of the airplane to such a degree that the time is now very near when airplanes will have such extended radius of flight as will make the preliminary reconnaissance of the unknown areas in the north and south polar regions a matter of a few weeks instead of several years."

The idea that aviators can now probably cover the ground to the poles in only two or three days' actual flight is fascinating. The old way takes two or three years and is attended with many hardships. Admiral Peary tells many interesting features about the country which polar explorers will encounter.

Arctic and Antarctic Are Unlike

North polar and south polar regions are very unlike. Few people appreciate the differences. The north pole is situated in an ocean some fifteen hundred miles in diameter, surrounded by land. The south pole is on a continent twenty-five hundred miles in diameter surrounded by water. At the north pole I stood upon the frozen surface of an ocean *more than two miles in depth*. At the south pole, Amundsen and Scott stood upon the surface of a great snow plateau *more than two miles above sea level*. The lands that surround the north polar ocean have comparatively abundant life. Musk-oxen, reindeer, polar bears, wolves, foxes, Arctic hares, ermines, and lemmings, together with insects and flowers are found within five hundred miles of the pole. On the great south polar continent no form of animal life appears to exist. The north pole, being in an ocean, is much harder to get at than the south pole. Arctic exploration goes back four hundred years; Antarctic one hundred and forty years. Yet both should now yield without great difficulty to the airplane.

Greenland, Peary suggests, should belong to the United States if it can be purchased. Like Alaska it is a valuable property intrinsically because of coal and mineral deposits. Also its bays and harbors are of strategic value. But the expression "cold as Greenland" is all too true. Probably the coldest regions in the world are atop of its mountains of ice far inland during the long winter nights, when neither sunlight nor the tempering winds of the ocean reach the region.

Greenland Is Buried in Snow

"The interior of Greenland," says Admiral Peary, "is so cold that it gets virtually no rain, and the snow does not have a chance to melt in the long summer day. So the snow has accumulated century after century until it has filled the valleys, and not only leveled them with the tops of the mountains, but the highest of these mountain-tops have been gradually buried hundreds and even thousands of feet deep in ice and snow. Today the interior of Greenland, with its fifteen hundred miles in length and some seven hundred miles in maximum width, rising from four thousand to nine thousand feet or more above sea level is simply an elevated and unbroken plateau of compacted snow.

"On this great frozen Sahara of the North the wind never ceases to blow. It invariably radiates from the center of the ice-cap outward, blowing perpendicularly to the nearest portion of the coast land, except when storms of unusually large proportions sweep across the country. So regular are the winds of these regions, and so closely do they follow the rule of perpendicularity to the coast, that it is always easy to determine the direction of nearest land.

Over such country as this will the airplanes fly. In south polar regions much the same conditions will exist, except that aviators must fly at greater altitudes because a continent rises high beneath them. Many geographical facts about polar regions are as yet undetermined. Those last lands unreached by man may be about to yield their secrets.

What the lands may contain is problematical. New races of men, perhaps, new and valuable hunting-grounds for fur-bearing animals, possibly, new coal deposits, new ore supplies; no one is sure just what until explorations are made. Alaska was considered a barren region until its vast mineral and other resources were discovered. Similarly we may be mistaken in our concept of north-polar regions and of the south-polar continent. If Rear-Admiral Peary's ideas take shape airplanes will find out.

When Airplanes Whizz Over the Pole

"In the very near future," says Rear Admiral Robert E. Peary in a new book, "Secrets of Polar Travel," "the biting air above both the earth's poles will be stirred by whirring airplane propellers"

A Phonograph for Lazy People. It Changes Its Own Records

A GLORIFIED phonograph has been patented by a young man in California. His phonograph will do everything but go out into the dining-room and mix a cocktail when the music is over.

Harry Scott, the inventor, gives the fruit of eight painstaking years to indolent humanity. His phonograph numbers among its achievements the ability to play both disk and flat records. But its forte is the cylinder. It will play cylinder records, one after another, without re-winding, without changing, indeed, without any more effort than sitting down in an easy chair and listening.

This phonograph does everything but provide the smokes and drinks for the company

Cylinder records are played in a vertical position. Eight cylinders are placed in pockets that permit the upper rim to project about one inch. The pockets are cut into a revolving platform. When one cylinder is finished, the table automatically revolves until the next cylinder is under the reproducing needle.

The operation is continuous. A button is pushed to start an electric motor. The same push button stops the performance. If intermissions between selections are desired, alternate records are removed. For dancing parties, it is obvious that the automatic changing mechanism has advantages.

Six patents have already been issued upon this apparatus. Besides accomplishing the feats outlined above, many little niceties have been incorporated. For example, when the lid is raised a frosted electric lamp flashes on. Lowering the lid switches off the lamp. Besides this, a small brush has been incorporated which follows the needle, carefully cleaning every record as it is being played. Another feature is an automatic oiling device which deposits one drop of oil in every important bearing at the necessary intervals. Small storage vaults for records, making the disks convenient of access, round out an apparatus that gives us an inkling of what the phonograph of one hundred years from to-day may resemble. At any rate most of us are innately lazy, so we at least think kindly of this inventor.

Here is an anomaly —an honest dice box. Is it possible?

The Desert Dry? Read This

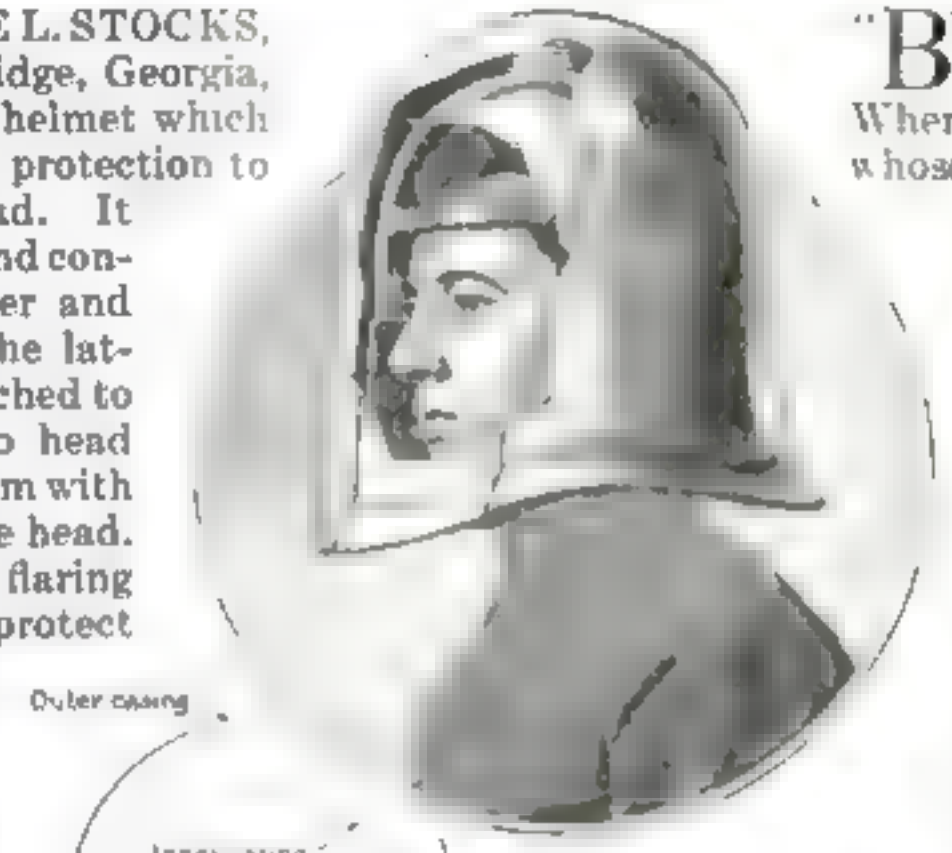
WOULD you believe that the air in an average schoolroom is drier than the air in the deserts? That is what recent tests indicated. However, there is nothing to be alarmed over, as the drying power of air does not depend so much on its humidity as on its being in motion. An interesting illustration of this is furnished by the fact that the air in a room which is fan ventilated and artificially humidified has greater drying power than the air in a naturally ventilated and humidified room.

"Come Seven! Come Eleven." Honest Deal Always

HONESTY in the manipulation of the dice is assured by a new dice box provided with a conical bottom and spiral ridges around the inside walls, as these make it impossible for the player to prevent the dice from turning over at every throw. The box is moulded from one piece of tough but flexible leather so that dice with the finest surfaces are not injured. The box is also practically untearable and unbreakable and outwears the average dice cup.

How Would You Like to Wear a Bell-Shaped Helmet With Shutters?

CLARENCE L. STOCKS, of Blue Ridge, Georgia, has invented a helmet which offers complete protection to a soldier's head. It is bell-shaped and consists of an outer and inner casing, the latter having attached to its interior two head bands to conform with the shape of the head. The helmet has flaring lower edges to protect the neck as well as the head. Two sight openings are provided in front for the eyes. However, the inventor has not neglected the wearer's nose and mouth. Two shutters fit snugly against the sight openings and are hinged to the outer casing so that they may be opened or closed as desired. U-shaped springs between the inner and outer casings are placed so as to reduce the shock from shell-splinters or bullets which may hit the helmet. The objection to this helmet would seem to be the limiting of the wearer's vision, for how can a man see quickly all around him through two small holes? It would certainly be very hot too.



The bell-shaped helmet is provided with shutters to afford full protection

The diagram gives the details of the new protecting helmet

The Amazing Nanny. Her Milk Is Worth Fifty Cents a Quart

"BUT, Doctor, I have tried everything!" When some anxious mother whose baby is suffering from under-feeding makes this rash statement, the medical gentleman appealed to is likely to smile encouragingly and ask, "What about goat's milk?"

Then in reply to the woman's curious or repelled expression he may explain the interesting experiments which took place at the Michael Reese Hospital in Chicago, where sick babies were fed on goat's milk with astonishingly good results.

So prepare to appreciate poor, maligned "Nanny." Here is a list of her virtues compiled by Mrs. Jessie H. Watson, who has a goat farm at Wycombe, Pa., and considers herself qualified to testify.

Nanny has brought back to health, not only many sick babies, but adults afflicted with indigestion or tuberculosis. She is the healthiest domestic animal in the world. She is non-tubercular and gives pure milk, of rich quality and fine flavor. She can be kept in much smaller quarters than a cow requires.

Contrary to popular belief, the goat is a tractable animal, easily tended by a woman or even by a child

The One-Man Animal Ambulance and What It Does

AN ambulance for animals which was recently placed into active service by the Humane Animal Commission of Los Angeles, California, presents many novel and ingenious features. The ambulance body is mounted on a motor truck, with the driver's seat in front, and the enclosure for the animal patients in the rear. Both parts are protected by a roof. The rear enclosure has side doors and a rear door, hinged at the bottom, so as to form, when let down, inclined gangways, reaching the ground The sides of the enclosure are heavily padded and the floor consists of a removable platform which rests on rollers and which is also padded.

1. Shows end door and standing horse
2 Shows side door for walking animals

The platform is removed from the car and rolled alongside the prostrate animal. A rope is attached to the feet and, by means of a windlass worked by the motor, the animal is pulled upon the platform. Then, by the same method, the platform is rolled into the car. The windlass will also raise the rear door after the loading is completed. Animals able to walk, are led into the enclosure by the rear incline and leave the ambulance at their destination through the side door. One man can operate the ambulance, and the animals are moved in comparative comfort.

Roller platform being drawn, with its burden, into the car by the power windlass

Wood That Gives a Wonderful Fluorescence to Water

RECENT investigations have led to the rediscovery of two species of trees known centuries ago, but never definitely identified and subsequently forgotten, the wood of which gives to water a most remarkable fluorescence. One of the trees with the scientific name *Eysenhardtia, polystachya*, is a small bushlike tree with small, fragrant white blossoms and is found in Mexico, while the other, *Pterocarpus indicus*, known to the natives under the name of *narra* or *naga*, is a giant tree growing in the forests of the Philippine Islands. Chips of the wood of these trees, placed in water over night, cause it to become highly fluorescent and to display, according to the degree of illumination, a wonderful variety of opalescent colors, ranging from golden yellow and rich red through green to a deep blue. The fluorescence becomes particularly pronounced under the influence of the ultraviolet rays of the spectrum. The active substance contained in the wood of the two trees which causes the fluorescence has not yet been determined or isolated. The first mention of this remarkable wood is found in a book printed in Seville in 1574. It was there spoken of as being a native of Mexico and was called *lignum nephriticum*.

Detecting Glucose in Jellies, Jams, and Kindred Confections

GLUCOSE in fruit preserves may be discovered as follows:

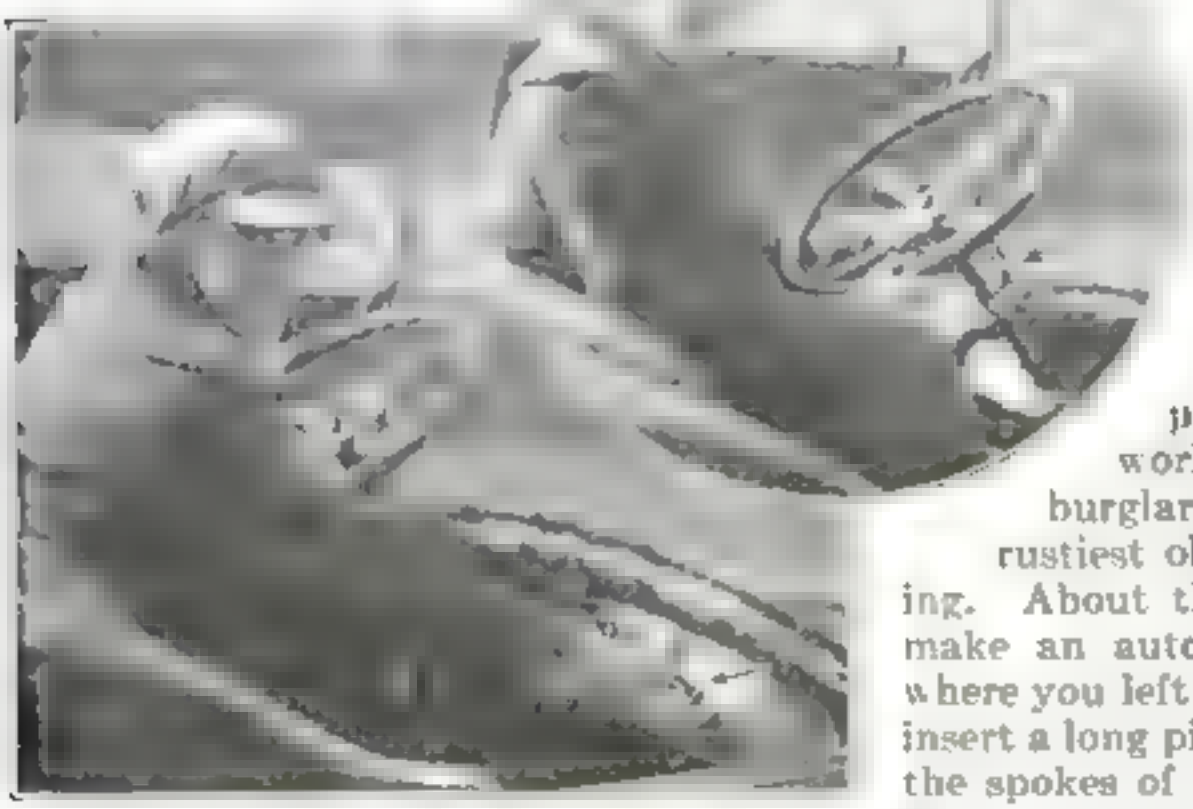
In the case of jelly a teaspoonful should be dissolved in two tablespoonfuls of alcohol contained in a glass vessel. In the case of jam or marmalade the same process is carried out, but it is necessary to filter off the solid matter by running the mixture through a piece of muslin. Allow the solution to become perfectly cool, and then add an equal volume, or a little more, of strong alcohol. If glucose is present a dense white precipitate slowly settles down. Where no glucose has been employed there is no precipitate, save, in some cases, a very trifling sediment of proteid matter which, however, is so small that it could not possibly be mistaken for the sediment which glucose produces. The last-named is not particularly harmful in itself, but it is very frequently used as an adulterant in supposedly pure preserves for extra profit.

This simple apparatus will enable you to detect the presence of glucose in jam and marmalade

Chain Your Automobile to a Hydrant If the Electric Lock Doesn't Hold

ADMITTEDLY, the stealing of automobiles has become a serious problem. John F. Hendrickson of Wollaston, Mass., would prevent it by installing on every car an electric lock. This shuts off ignition circuits, current to the starting motor, and also locks the steering wheel when the owner withdraws the key and leaves the machine.

The circuits are too complicated to reproduce in detail here, and also vary with the make of car. The contacts inside the electric lock are so arranged that, by resetting certain pins, at any time it is possible to change the combination and thus foil the thieving proclivities of a chauffeur or other person who has almost familiarized himself with the system and is about to make a get-away with the car. Elaborate auxiliary devices are also provided to prevent unauthorized removal of any parts of the system in an attempt to get at the inner wiring.



A complicated electric lock, designed to thwart attempts to steal an automobile

Contrivances such as this, though commendable in their effort, practically all fall down because the feat is almost impossible. It is always possible to get at inner wiring in one way or another, and a knowing thief can soon devise impromptu wiring that will work. It is an axiom among burglars that the simplest and rustiest old locks are the most baffing. About the only way effectively to make an automobile stay in the place where you left it, against all comers, is to insert a long piece of railroad rail between the spokes of the hind wheels and chain it to a convenient hydrant—and then there would be sure to be a fire.

Spotting the Submarine From the Observation Balloon

THE man who, in his youth was adept at climbing ropes, performing on the trapeze and in indulging in other acrobatic feats finds limitless field for the use of his skill in this war. Here we have a French observation-balloonist sliding down a rope from his basket to a steamer that has been towing him around. A hard day's work has just been completed. He has been looking for submarines in English waters, directing the work of destroyers, and otherwise acting as a lookout. It is climb around in rigging adjusting apparatus, slide down ropes, strain eyes out over wide stretches of water, and operate delicate wireless apparatus all day long. The responsibility and strain are great, and it needs a man in tip-top condition and with a natural aptitude to do the job.

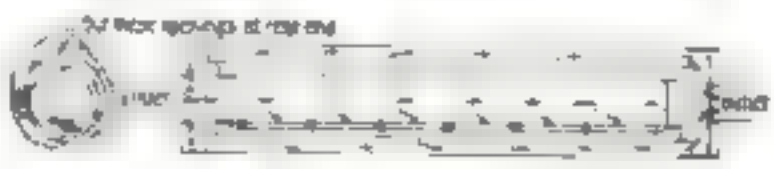
© Underwood and Underwood

Observer slides down after looking all day from a kite balloon for submarines and other hostile craft

Both armies and navies of practically all the countries at war use observation balloons in great number. They are indispensable for finding out what opposing forces are doing. The side temporarily without balloons is blind. The observer's job is one of the least spectacular and most important in the whole of the service, and requires men fit in every way.

Using a Maxim Silencer as an Automobile Muffler

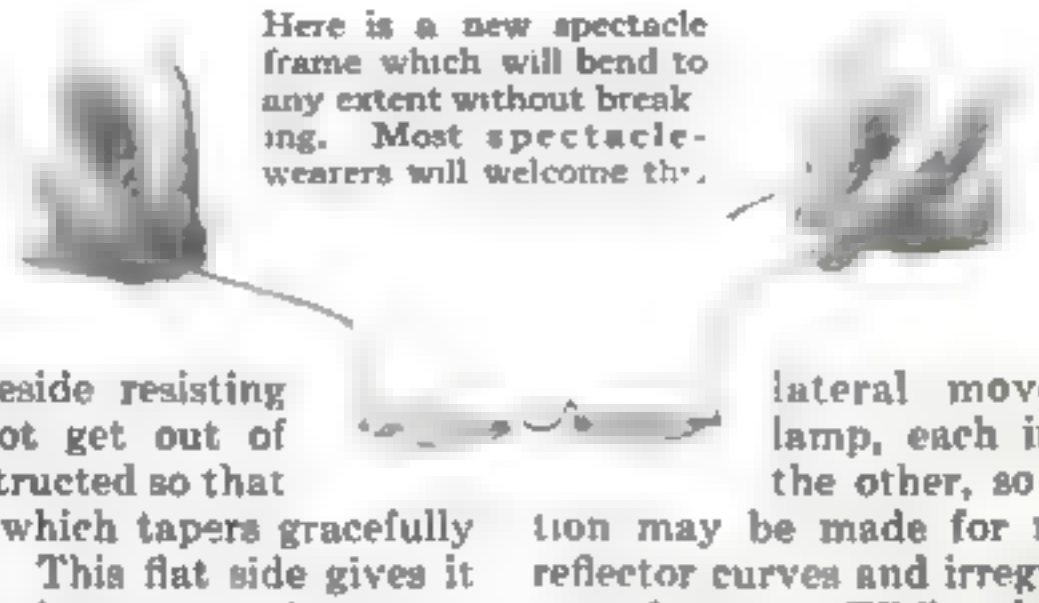
IF, said one western manufacturer, the Maxim silencer will deaden the sound of a gun explosion, why would it not deaden the noise of the automobile engine's exhaust? Convinced of the soundness of this argument, the manufacturer has just placed on the market the Maxim muffler shown in the accompanying illustration. While cylindrical in shape like other mufflers, the new type has no baffle plates or perforated disks through which the gas must be forced, so that the muffler is eventually torn apart through the direct impinging pressure of the gases, to the accompaniment of rattles, which are the automobilist's bane. Instead, it has two end plates with a series of non-concentric tubes between. As shown, each tube has an overlapping opening into the one of the next larger diameter through which the gas may expand gradually on its way from one end of the muffler to the other. As everyone is aware, it is the sudden expansion of the hot gases under pressure, to the atmospheric pressure which produces the noise. The object of a silencer is to allow them to expand so gradually that when they reach the outside aperture they are at atmospheric pressure.



New silencer for automobile engines on principle of Maxim silencer for guns

A Side-Piece for Eye Glasses Which Will Not Break

ONE of the new devices for glasses, of interest to the person who uses the style with side-pieces, is a very flexible side-piece which does not break even when it is subjected to considerable bending. The new side-piece, beside resisting breaking, does not get out of shape. It is constructed so that it has a flat side which tapers gracefully to the end piece. This flat side gives it springiness, so that it returns to its proper position after being bent in or out. The construction of the side-pieces also keeps the glasses from getting out of alignment.



Here is a new spectacle frame which will bend to any extent without breaking. Most spectacle-wearers will welcome this.

All wearers of spectacles will appreciate this innovation. Everyone knows the ease with which the ordinary spectacle frame can be damaged, and such breakages, if they come at all frequently, are very expensive. Outdoor workers, in particular, will welcome a spectacle frame that is unbreakable. It is not only the frame that is likely to break, but, on rimless glasses, the lenses may go. A frame which will take up any strain to which it may be subjected will save them.

Focusing the Locomotive Headlight With a New Adjusting Device

THE electric headlight of a locomotive can be focused with a very high degree of precision by means of an improved micrometer focusing device. It provides for vertical, horizontal, and lateral movements of the lamp, each independently of the other, so that compensation may be made for non-symmetrical reflector curves and irregularities of lamp manufacture. While a high degree of accuracy is possible, the adjustments may be made by a person inexperienced in the handling of instruments of great precision. Each moving part is spring cushioned against the wearing effect of locomotive vibration. The device may be also used when an oil or gas burning headlight is converted to an electric light, as any experienced mechanic can install it.

The focusing device described above permits of exceedingly fine optical adjustment of locomotive headlights, and the penetrating power is very considerably increased by its use

"Educated" Ants the Latest Thing in Animal Training

THERE is a great fascination to many persons in the difficult task of training animals and it is remarkable how wonderful has been the success of some trainers, especially of animals noted for their high intelligence But, the efforts of the training enthusiasts have not been altogether confined to the higher animals; they have included some of the less gifted creatures, and have even interested themselves in the pesky flea.

Coughlin's troupe of performing ants. The commands must be spoken in Antese, we anticipate

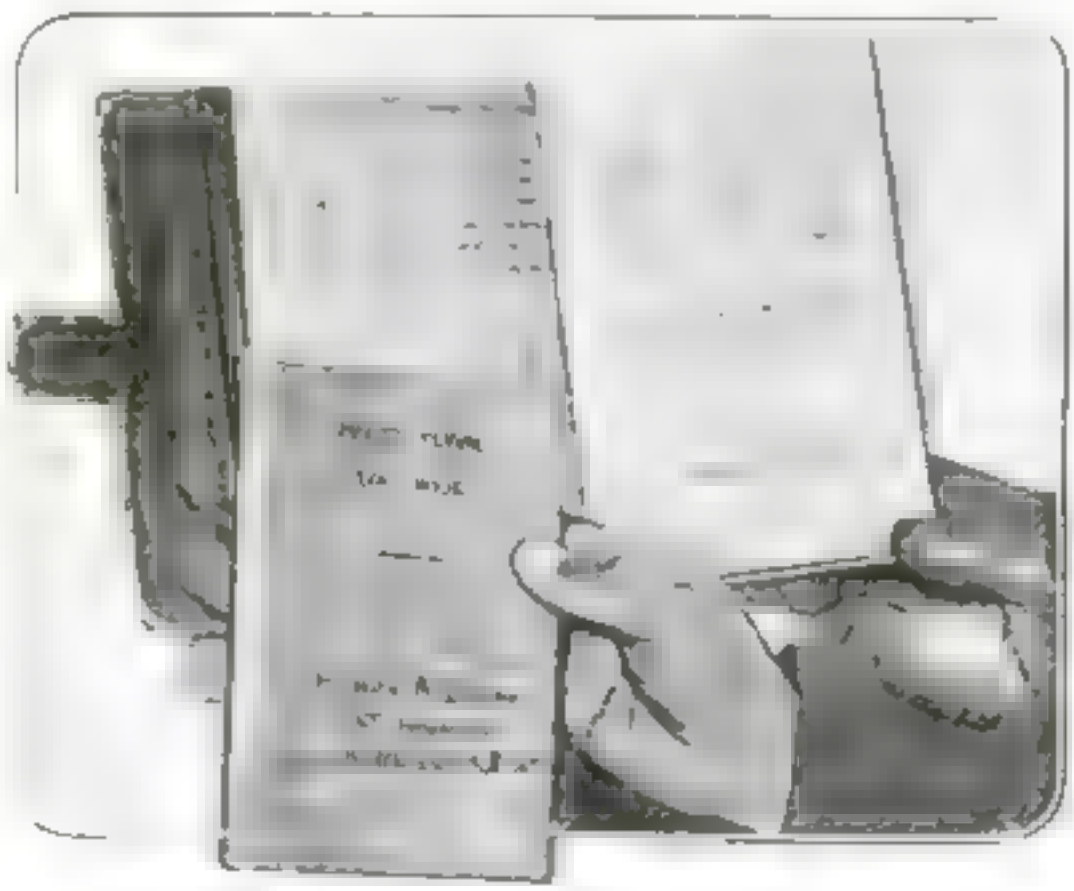
The accompanying picture shows that even ants have been used for pedagogic experiments. John W. Coughlin, of Ellsworth, Me., succeeded in training these Madagascar ants to perform certain military movements and other tricks which are said to be remarkable. It is not reported which language the trainer used in giving his commands; at all events the insects must have understood it, for they obeyed the commands.

The Air Pilot's Flying Log Book and How It Is Used

YOU have heard of ship's log books, but here is a new kind of log—a small, tan, leather-covered book, seven and one-quarter inches long and four and three-quarters inches wide. On the cover is the title "Pilot's Flying Log Book." Every airman in the British Royal Flying Corps has one of these books issued to him the day he takes his first lesson in piloting an airplane. Until he is honorably discharged or killed in action he must enter a record of each flight he makes. At the end of each week the number of hours in the air and also the number of landings made are totaled and signed by the officer commanding the squadron to which the airman is attached, one of which is clearly shown in the illustration. Note that this particular page is signed by the ex-dancer, Captain Vernon Castle, Commanding No. 84 Canadian Training Squadron.

The first entry in this log book gives one an idea of the dangers of the air. Engine trouble forced the pilot to make a landing. A forced landing is difficult and dangerous, but as there is no mention of damage, it must have been made safely.

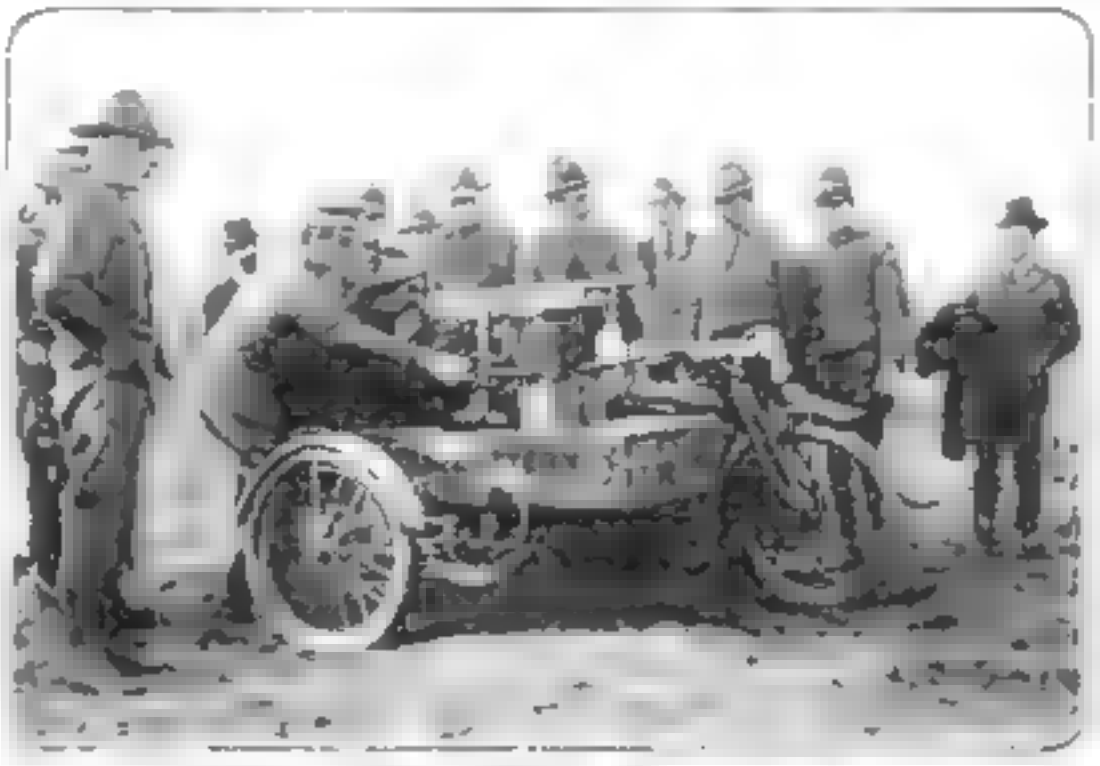
It is said that truth is stranger than fiction and if all the reports that filter through and reach us through the medium of the newspapers are only half true, the log of an airman must be a masterpiece. Jules Verne wrote strange stories, but present-day facts leave even them behind.



An airman's log book. Each flight is recorded and each book must be almost an epic in itself

The Motorcycle as a Valuable Asset in War Operations

FROM the arrival of the British Expeditionary Force in Belgium in the late summer of 1914 down to the present time, the motorcycle has steadily gained in importance in different branches of the military service. Its use has not been restricted to the Allied armies. The best authorities place the number of motorcycles employed by the armies of the Central Powers, at the time of the Battle of the Marne, at 18,000. The British had at least 40,000 in service in the Spring of 1915, while the French had about 11,000. The Italian forces, up to the present, have 10,000 according to recent estimates.



Japanese motor vehicle experts study our motorcycle machine gun units and methods

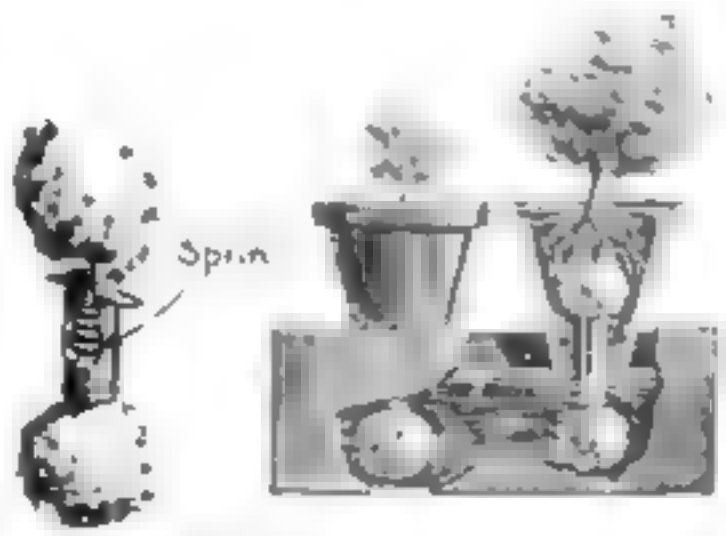
It has been figured that more than 750,000 motorcycles have been in use for military purposes by the belligerent powers since July, 1914. This does not include those at present in the United States Army services, for prior to our entrance in the Great War, the American Army did not have more than perhaps 150 machines in all.

Before the era of trench warfare on a large scale, the greater number of motorcycles in use were for despatch riding. By reason of its readiness for use at a moment's notice and its ability to thread its way among the heavy traffic behind the lines, the motorcycle superseded all other means employed for carrying despatches between headquarters, often long distances apart.

Another important use of the motorcycle in war is that of convoying supply trains from base to distributing stations along the front. The flexibility of the motorcycle makes it particularly valuable for such work. Motorcycles have also been used in considerable numbers, to convey picked riflementopoints on the front where reinforcements are needed, and whole battalions are sometimes transported in this manner.

Supplying Water to the Thirsty Rootlets of Potted Plants

THE device illustrated, once installed, will reduce to an absolute minimum the work of keeping the potted plants supplied with the required amount of water. It consists, in its main feature, of small tubes containing sponge or some other water-absorbing material, which protrudes from the tube at both ends. These tubes are inserted with their upper end through the hole in the bottom of the flower pots, so that the sponge reaches well up into the soil surrounding the roots, while the lower part of the tube with its corresponding sponge end goes through the cover of the pan or receptacle, upon which the pots are arranged, and reaches into the water with which the pan is filled.



This little arrangement will save much trouble if you grow plants

Capillary attraction carries the water up the tubes and the plants are thus thoroughly irrigated.

The Automobilist's Automatic Pathfinder on the Steering Column

EVERYONE who has ever toured to any extent over unfamiliar roads in an automobile, knows how inconvenient it is to have to stop every few miles and compare the reading of his speedometer with the distances as given in his route book. Even if a member of the party sat on the front seat and called off the mileage readings and the landmarks, it is often necessary to slow down or turn back to find one's bearings.

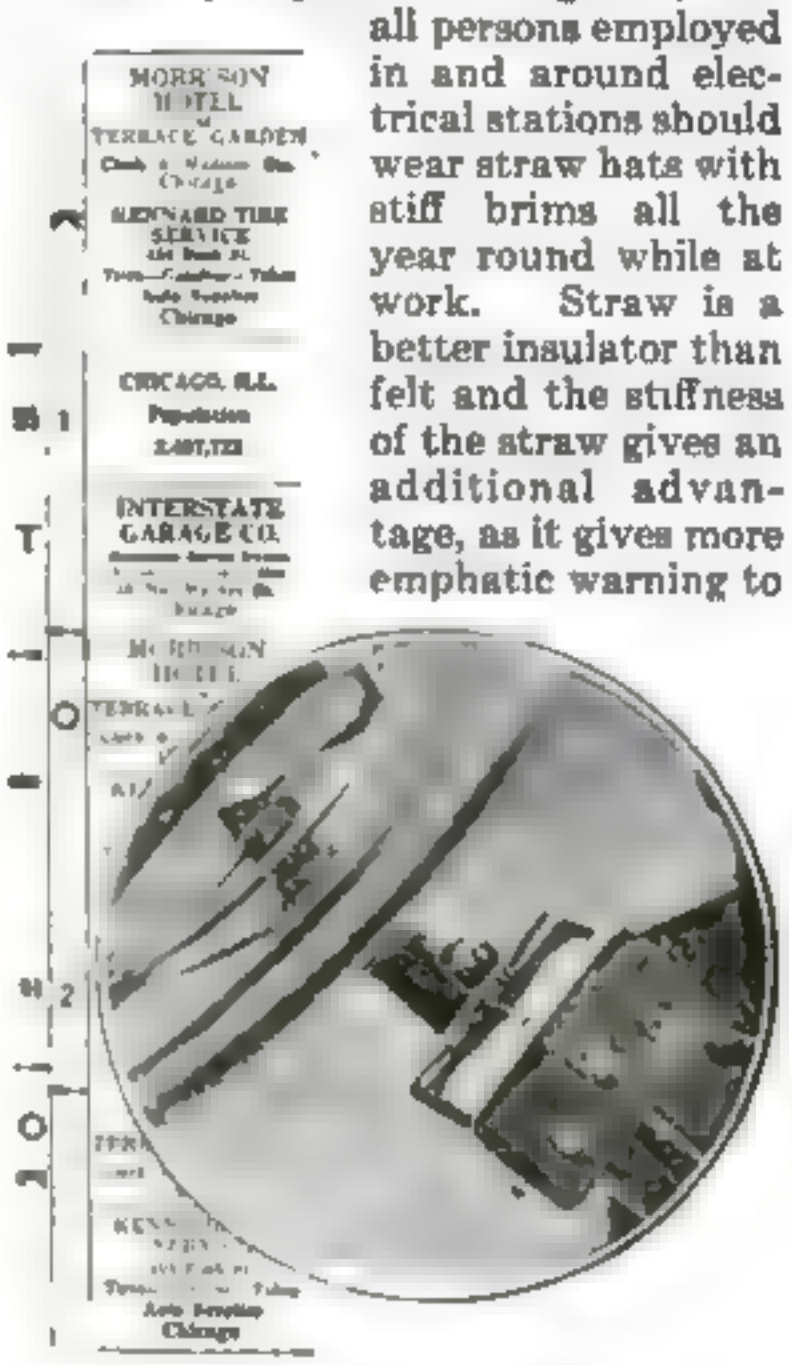
All these difficulties have been eliminated by means of an automatic route book which is mounted on the steering column of the car directly under the steering-wheel where the driver can look at it without taking his hands off the wheel. The new type of book has no pages to turn or no places to find. It consists of a small metal box carrying a tape on which is printed for any particular route, the turns of travel as indicated by arrows, and other symbols for steam and electric railways, dangerous curves, bridges, garages and hotels. The tape also supplies information on road conditions, traffic laws, and other historical points of interest. A full mile of travel is always visible on the tape and in this way prepares the driver in advance for any unusual or dangerous road conditions, crossings, steep hills, etc.

This is a sample of the tape and the indicator on the steering column that does away with cumbersome route books

A separate tape is required for each route. All that the driver has to do is to start the tape at the point indicated. The tape mechanically unwinds from a roll in one end of the case and winds up on a similar roll the other, the movement being provided by a flexible shaft geared to either front wheel in much the same manner as a speedometer.

Electricians Should Wear Straw Hats While at Work

A SUGGESTION has recently been made by a prominent engineer, that all persons employed in and around electrical stations should wear straw hats with stiff brims all the year round while at work. Straw is a better insulator than felt and the stiffness of the straw gives an additional advantage, as it gives more emphatic warning to the wearer of the hat when he comes in contact with a wire or apparatus carrying electricity of high tension. It may seem ridiculous to wear a straw hat in zero weather, but—safety first!



And Now We Wash Ourselves in the By-products of Garbage

NEW York city's plant on Staten Island for the reclamation of garbage produces the necessary fat for ten million cakes of soap yearly, and also the nitrogen and glycerin for the manufacture of seven hundred thousand pounds of high explosive. In addition to this, much phosphoric acid and potash are reclaimed and sold for fertilizers. This is effected by the so-called Cobwell process.

Novel Application of the Service Flag Idea on a Girl's Belt

ONE of the latest applications of the service flag idea was displayed recently in public by Miss Evelyn Grieg of New York and attracted favorable attention. Upon her broad patent leather belt she displayed four stars in token of the patriotic devotion of four members of her immediate family who have joined up to help make the world safe for democracy.

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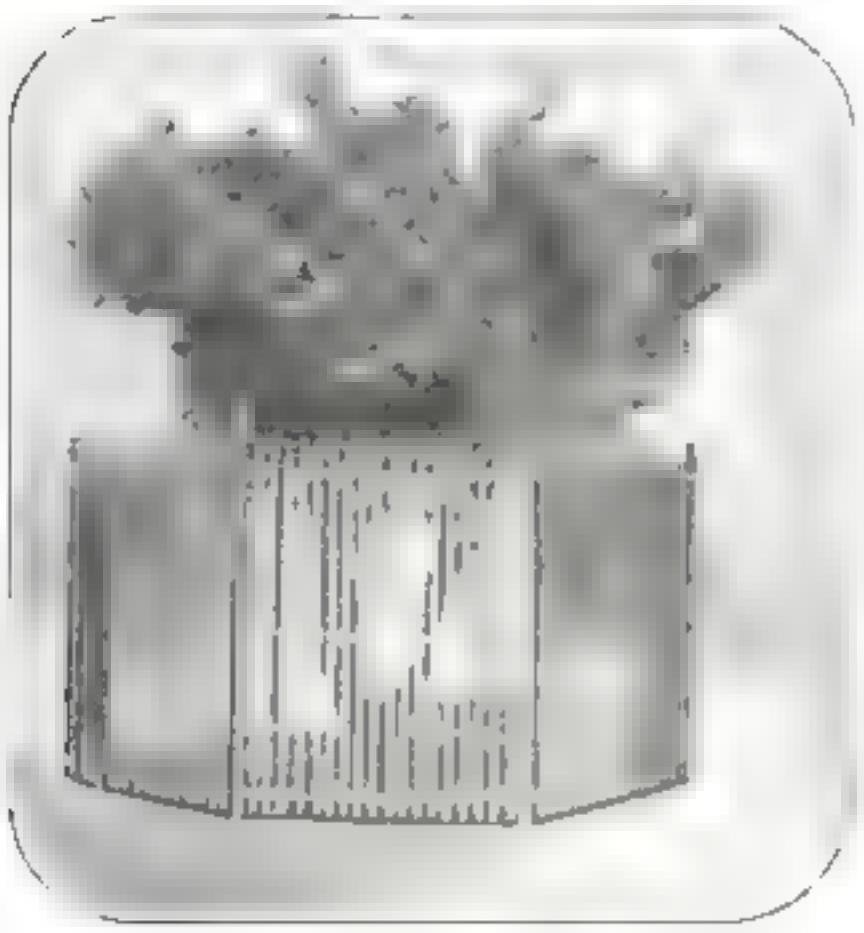
Belt advertising the number of relatives one has in the services

Orange Tree Made Riverside Rich

IN 1872, United States Consul to Bahia, Brazil, Mr. W. F. Judson, was told by the natives that some sixty miles inland, up the Amazon, were native orange trees bearing fruit without seeds. Accordingly he sent natives after tree shoots and some of the fruit. The shoots were packed in moss and clay and sent to Washington. They were set out by the Agricultural Department, but attracted little attention until the next year, when Horatio Tibbetts, of Riverside, California, took the surviving four shoots to his home and planted them. One died and another was eaten up by a cow. At the end of five years the two surviving trees bore sixteen handsome seedless oranges. Next year the oranges were even better, and the trees bore about a box of the fruit.

From that time on the cultivation of the seedless oranges about Riverside progressed rapidly. As there were no seeds to raise the trees from, it was found necessary to graft buds of the seedless trees into seedling trees.

Riverside has grown from a small village to a town of fifteen thousand people, and has twenty thousand acres devoted to the cultivation of navel oranges. It is the greatest orange producing locality in the world. The two original trees were fenced about and carefully guarded lest harm should come to them, and they are now enjoying a green old age. One of them is shown herewith.



The grandfather of navel oranges. One of the two original seedless orange trees

Heavy Artillery Is the Correct Weapon for Shooting Canaries

DURING some recent mining operations beneath the German trenches, some canaries were, as usual, taken into the excavation to indicate the presence of noxious gases. One of these little songsters escaped and flew to the middle of "No Man's Land," where he perched on a shrub and began to sing. Fearful that the Germans would notice him and so discover that mining operations were going on, the British opened fire on him, but he seemed to bear a charmed life. The sharpshooters tried to "get" him, and the rank and file took pot-shots at him, but still the liquid notes flowed over the landscape. Finally, in desperation, he was fired on with trench guns and a well-placed shell obliterated bird and bush and song.

Using Absorbent Cotton Over Again

France has not enough cotton for her wounds, so a chemist invents a cotton rejuvenator to cleanse the old

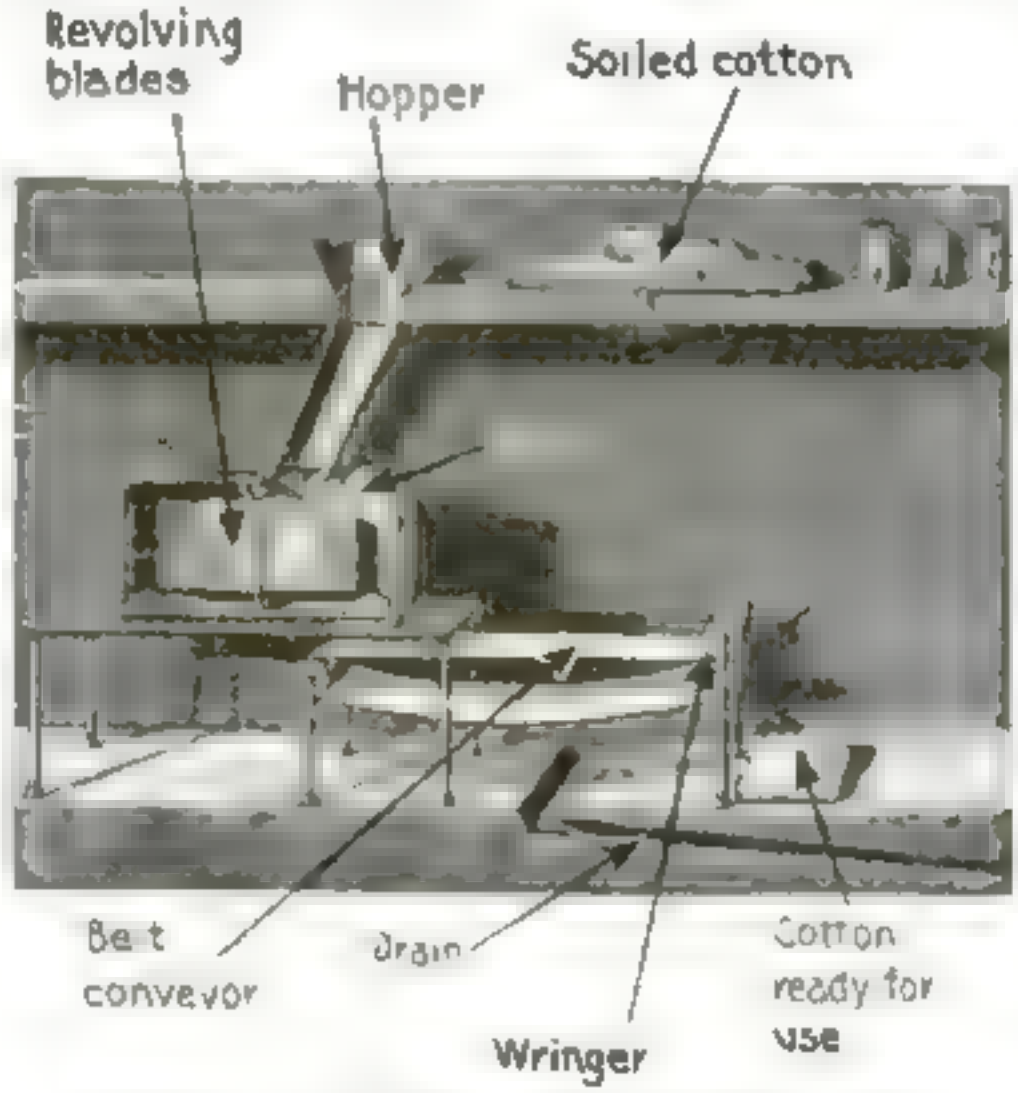
MAKING use of absorbent cotton that has been soiled by a wound, no matter how sterile it may become by any process, seems repulsive. But, to paraphrase General Sherman, war is *war*, and a French chemist, B. Villey, has undertaken, successfully, to supply his country's wants.

Impressed by the huge demands, the demands that could not be met, for absorbent cotton for wound dressing, Villey set about rejuvenating absorbent cotton which had been used and discarded.

It was a colossal task. Killing the germs in used cotton was the smallest part of it. Absorbent cotton must have "life." It must be springy; it must *absorb*. He developed one type of machine to do this work, and then another. Popular opinion was against him. It was a long, up-hill struggle. But at last he succeeded. He had won! He had evolved a process for making old cotton as good as new. It was fine, white cotton, as springy as ever. It *absorbed*.

Did the medical authorities seize upon it with gushes of enthusiasm? Did they hasten to pin upon him the *Croix de Guerre?* They did not. His proposal was passed along from department to department, each one withholding the stamp of approval. Finally someone noticed it. The cost of rejuvenated cotton was compared with the cost of new cotton and found to be about three to one, in favor of rejuvenated cotton. The two were compared physically. Then came the hoped-for gush of enthusiasm.

Villey's cotton rejuvenator is quite simple. Any hospital can install and operate the machine in a modified form. Many hospitals have done so. Villey will modestly tell you that the demand exceeds his expectations.



Machine for Reclaiming Soiled Absorbent Cotton

The soiled cotton is dumped into the hopper and passes down into the vat. Here it is treated with powder and chemicals, being at the same time agitated by the revolving blades. After this it is washed and is again treated, this time with soda solution to extract the fat and grease. Finally it is restored to its original whiteness in a bath of hypochloride of lime. The clean cotton is ejected on the endless belt. $1,000,000 is saved annually

Soiled cotton is dropped down a chute into a large vat where it undergoes several treatments. First, all germs are killed and all poisonous matter removed by chemicals and washing. An objectionable element still remains. This is grease, or fat, which has been drawn from the wound, and takes the form of a sheath. It is boiled out in a solution of soda.

The mass is now whirled about by revolving blades or paddles, not unlike the way dirty clothes are whirled about in a washing-machine. Well washed and drained, the cotton is restored to its original whiteness in a bath of hypochloride of lime. Repeated washings and sterilizings follow and it is at last dried. The process saves $1,000,000 annually.

The Metal Hose Man and How He Was Manufactured

AT the recent automobile show in New York, an exhibit of a Newark manufacturing company attracted much attention. Its exhibit was a man-shaped figure composed entirely of specimens of its various kinds of hose.

The height of the figure was three feet. In its right arm it held a section of big tubing, five inches inside diameter, interlocked. The hat was built from smaller tubing used for wire covering. The body was made of carbureter hose packed with asbestos or a heat-proof fiber, and employed by automobile manufacturers. The feet and hands were made from exhaust stoves or hoods. Ears and mouth were oil conveyers which shoot greasy compounds, kerosene and cutting oils upon machine work for rapid and accurate production. The legs were of pressure hose. Small electric lights formed the eyes.

This quaint figure is made entirely from flexible metal hose and fittings

What a Woodpile! It's Three Hundred Feet High

PROBABLY the biggest woodpile on record, shown in the accompanying picture, is to be found at Berlin, New Hampshire, the center of an important paper-manufacturing district. The pile, which forms a respectable hill, plainly visible from a great distance, is composed of more than seventy-five thousand cords of wood which are to be made into paper.

An idea of the size of this pile may be gained from the fact that its highest point is nearly three hundred feet above the ground, while its extreme length is more than one thousand feet, or nearly a quarter of a mile. Some statistician has figured out that, if these logs were split up into cord wood and laid in a straight line, they would reach nearly twice around the earth. The potential number of miles of newspaper it contains must be fabulous.

This is not a slag-heap, but a great pile of logs of spruce and other pulp-wood, which is destined eventually to arrive at your breakfast-table in the form of newspaper

New Method of Mounting Unbreakable Watch Crystals

TO overcome the inevitable loosening of the crystal in watches suitable for soldiers' wear one manufacturer clinches the rim into the crystal as shown in the accompanying illustration. The crystal employed is likewise made of a compound that will not burn, thus forming an ideal device for wear in the open or where the watch is liable to receive hard knocks.

This crystal is clamped into the watch rim to prevent loosening

Acetylene Trench Gun—It's a Great Thrower of Shells

ACETYLENE gas does not work well as an engine fuel. It is too explosive. However, a Paris inventor, R. A. Brévaire, would turn this to good use in a trench-gun.

The lower part of his machine consists of a chamber into which air is forced under pressure, or sucked in by the rush of an outgoing shell. Having thus filled the chamber with air, the operator next admits a small quantity of acetylene gas by means of a valve. Air and the gas intermingle forming a highly explosive mixture. This is set off at will by means of a spark plug and a suitable coil. Shells are inserted in the gun by dropping them through the muzzle, rear-end foremost. If the gun-barrel is unrifled, wings at the base of the shell make it spin and fly true. A sound-deadening chamber is fastened to the outer end of the gun; it is built on the principle of an automobile muffler.

This gun is new in being the first trench gun to use gas as an explosive.

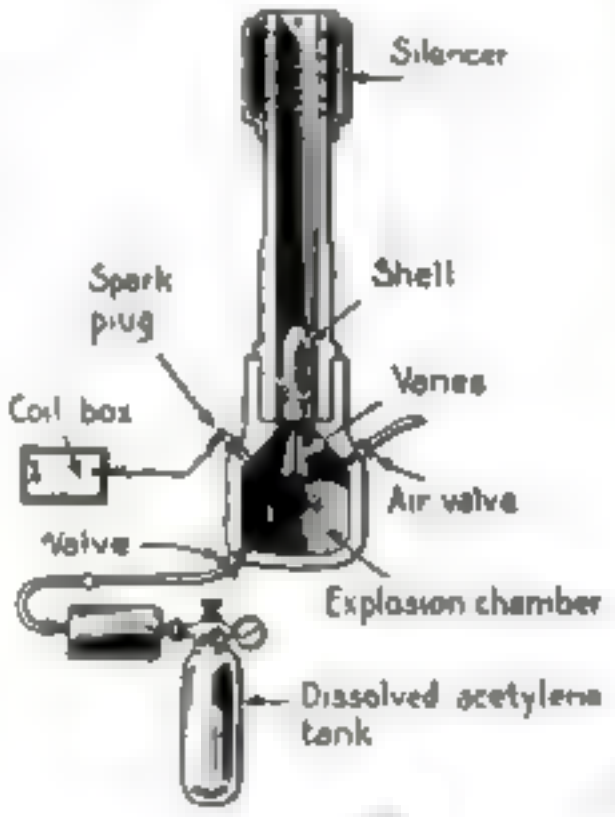


Diagram and illustration of a new acetylene trench mortar, fitted with silencer and recoil mechanism. Acetylene is too explosive for automobiles, but this is a virtue in guns

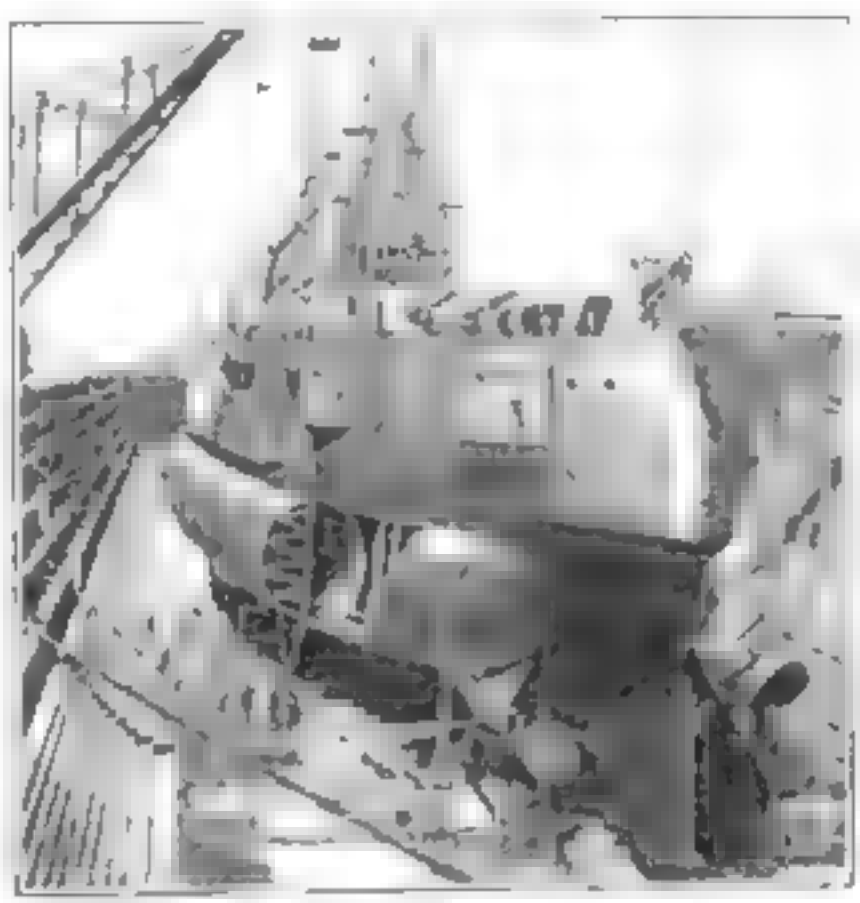
Poisonous and Harmless Mushrooms Difficult to Distinguish

IN a special bulletin published by the U. S. Department of Agriculture special emphasis is laid upon the fact that there is no simple test for distinguishing between edible and poisonous mushrooms. Many of the alleged distinguishing marks used by farmers, dealers and purchasers of mushrooms to differentiate between edible and poisonous mushrooms are considered by the experts of the Department entirely fallacious or too unreliable to be used with safety. The only safe mushrooms to eat are those gathered by a collector who knows exactly what he is doing. Only such mushrooms should be picked as are known to be non-poisonous and all mushrooms, which in any way differ from the known type of edible varieties should be left severely alone. Every season there are numerous fatalities from eating the poisonous varieties.

Torpedo-Proofing Ships with Air Tanks

Air-cushions to run along sides of ship are proposed as a protection against torpedoes

SINCE the beginning of the Great War, and particularly since Germany adopted the submarine policy, the brains and ingenuity of inventors of all classes and ratings have been directed toward finding some means of counteracting the destructive effects of the torpedo. Many expedients have been suggested, ranging all the way from extremely feasible propositions to the wildest vaporings. The following article deals with one of the more probable ones.

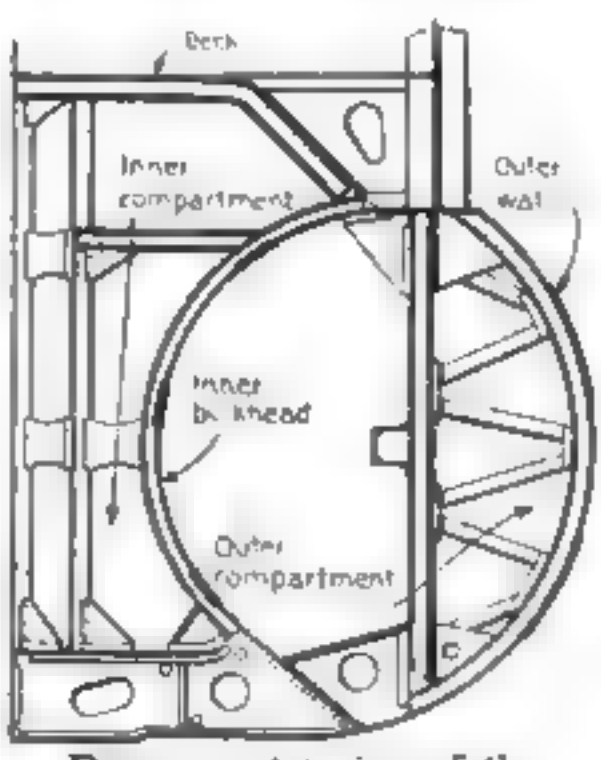


A cruiser in dry-dock, showing how the air-chambers are attached below the waterline

Hudson Maxim, who has, himself, suggested a method for torpedo-proofing ships in which he makes use of the principle of the "gun silencer," states that the explosive charge in the war-head of a modern torpedo consists of about four cubic feet of T.N.T. (tri-nitro-toluol). When the detonator inside the charge is fired the T.N.T. explodes, and within less than the twenty-thousandth part of a second the four cubic feet of explosive are transformed into 40,000 cubic feet of gases, having a temperature of about 5,000 degrees F. The mass of water surrounding the explosive offers a greater resistance to the sudden expansion of the gases than the wall of the ship and as the expansion follows the line of least resistance, the wall of the ship is crushed and the expanding gases enter into the body of the ship with destructive violence.

With this picture of a torpedo's effect before us we are prepared to understand the invention of Thomas G. O. Thurston, of London, England, recently patented in the United States. Thurston, taking the terrific expansion of the gases generated by modern explosives into account, seeks to provide a system of large resistance and expansion chambers which act like an air-cushion by which the force of the inrushing gases is smothered and robbed, to a great extent, of its destructive potentiality.

The inventor proposes to construct these shock-absorbing chambers along the sides of the ship for a suitable distance forward and aft. He suggests various forms, all showing a decided bulging outward, beyond the normal contour of the ship. The back of these bulging outer chambers, formed by a suitably stiffened bulkhead or inner framework, separates the outer chamber from the inner compartment, which provides the final and strongest resistance to the expanding gases. This inner compartment has a strongly braced back, curving inward toward the interior of the ship, and the air contained in it is intended to act as an additional cushion.

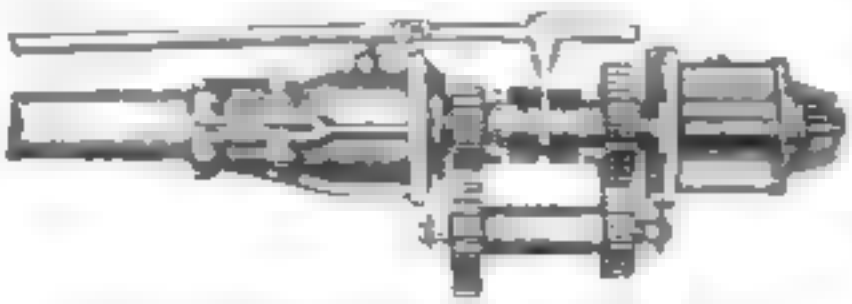


Diagrammatic view of the latest torpedo protection

Giving Fords a Greater Pulling Power for Heavy Loads

ALTHOUGH in passenger car service the Ford car generally has adequate pulling power for all kinds of hills, there are times when it is used as a delivery truck that still greater power at low speeds would be advantageous.

This device is inserted in the regular Ford driving shaft just forward of the rear axle and consists of a small case enclosing a series of gears which are always in mesh. This constant-mesh feature distinguishes the invention from the gears of the average passenger car in which each gear is out of mesh except when transmitting power. In the device illustrated the gears, while always in mesh and turning, transmit the power only when they are locked to the shaft by means of jaw clutches. These can be slid into mesh with much less chance of stripping than the gears themselves.



This auxiliary gearset gives a Ford more reserve power on hills or with heavy loads

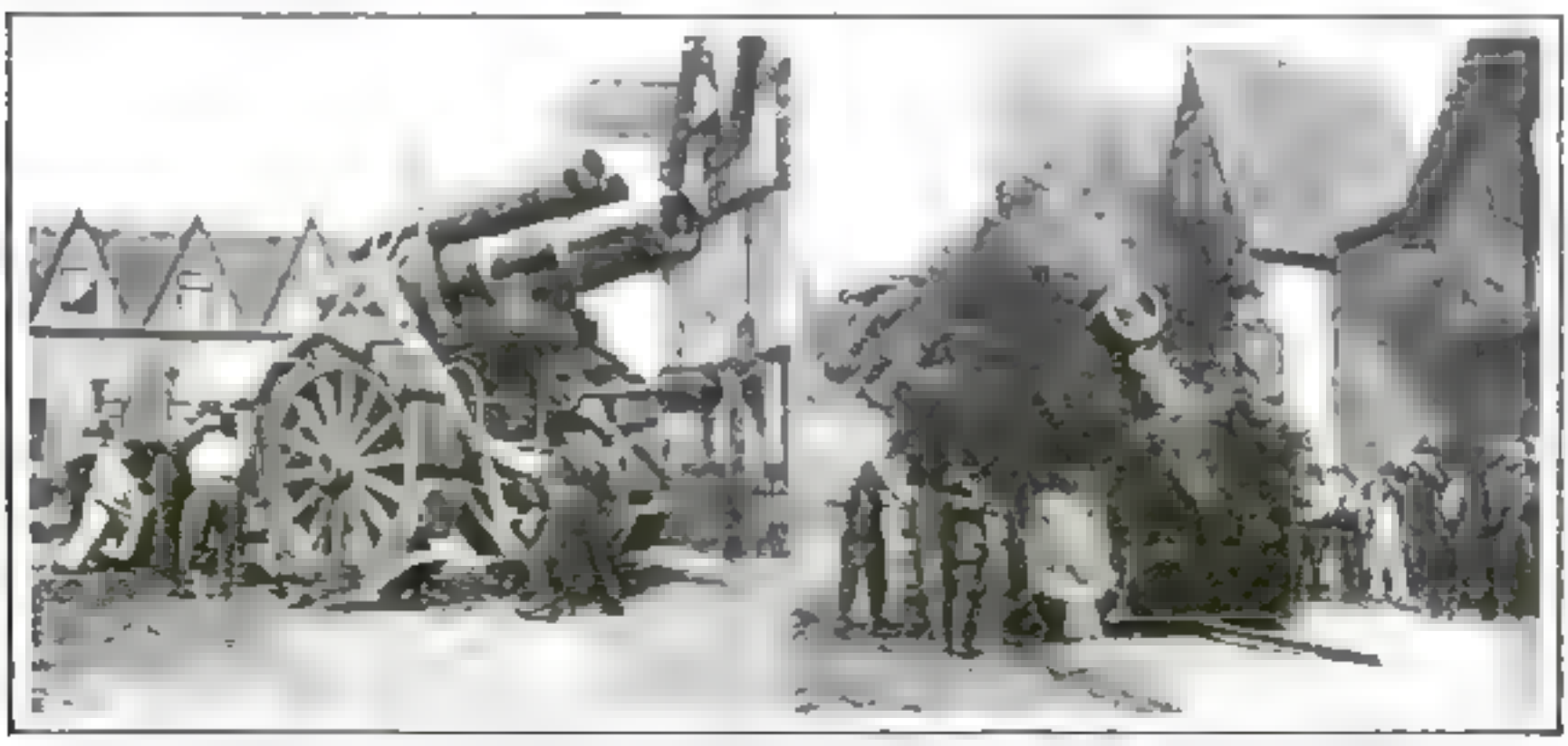
The Ford car is operated as usual, except when additional gear driving ratios are required. Then the auxiliary gearset control is operated to give three additional ratios, one in low, one in reverse and the third in intermediate speed, thus giving the engine almost double the flexibility.

The Motion-Picture Scene-Shifter Enters the War

POOR Fritz will never again believe what he sees, or believe what he thinks he sees. "When is a tree not a tree," is going to become a more terrifying conundrum to him every day. This is the reason why:—Moving picture men are going into the "camouflage" business.

Some of the recruits of a newly organized United States Army corps are experienced motion picture men. A full company has been raised in the Los Angeles studios alone. Another company stands ready to be enrolled. The men are eager to use their skill to "make up" imitation cannons, tanks, machine guns and other grim actors for their parts at the Front.

A recent demonstration, held in one of the great Los Angeles studios, revealed the possibilities of "camouflage." The wizards of illusion raised a village in the twinkling of an eye; tore it down with equal dexterity, and in an incredibly short time substituted a startlingly perfect "camouflage" forest. The fairy-tales of our youth, in which genii and fairies raised and removed castles by magic, seem to bid fair to come true in these days of seeming miracles.



Two masterpieces in camouflage. The first is a sham "gun." In the second, village, gun, smoke, and all, are, for practical purposes, "of the stuff that dreams are made of"

A Sweet Potato Digger That Lifts the Potatoes and Cuts the Vine

A NOVEL potato digger for sweet potatoes, invented by Oliver Cordrey, of Laurel, Delaware, digs deep under the potatoes and lifts them out, leaving the ground level with the vines on top for a cover through the winter, instead of turning the vines under a furrow as a plow would do. The ground is left in condition for raising better corn the next season where that crop is used in rotation with sweet potatoes.

The machine has a pair of runners arranged at opposite sides of the beam, which each carry a small cultivator disk. These runners are adjustable vertically. Back of the runners is a scoop, having upwardly extending rear arms. This scoop is adjustably mounted so that it may be tilted relatively to the beam.

So long as farmers used the old plow for turning out their sweet potatoes they could not raise corn the next year. The vines were covered at the bottom of the furrow and the subsoil turned up to the winds of winter, since it was necessary to plow deep to avoid cutting the potatoes. The new digger obviates this and cuts the vines as it digs, thus performing what formerly were separate operations. The resulting saving in labor is from $5 to $10 per acre—figured on pre-war prices. The machine is of light draft, simple in construction as compared with most machines designed for potato digging, and is self guiding after being started in a row.

As the digger is comparatively inexpensive, and the saving effected is very considerable this should prove very popular, particularly with small truck farmers. The fact that the machine can be run by unskilled labor counts.

A potato-digger constructed to lift out the potatoes without turning over the earth like the old plow

The little apparatus shown weans a calf without separating him from his mother

An Effective and Humane Method of Weaning a Calf

RUSTIC ingenuity has devised a number of contrivances to prevent calves from nursing while they are in the same stable or the same pasture with their mothers, but most of these devices are extremely clumsy and awkward. The device shown in the picture avoids most of the objectionable features of the older appliances. The upper part is fastened to the nose of the calf by a hinged clamp and causes neither pain nor injury to the animal. The lower part, which is hinged to the nose part and swings freely, makes it impossible for the calf to nurse, although it does not prevent it from grazing.

This obviates the necessity for keeping the calf confined.

"Mothers" for Airplanes at Sea

How the Atlantic Ocean or the war zones can be protected with relays of seaplanes

By A. L. Aldey

AERIAL convoys for transports and merchant vessels crossing the high seas, aerial protection for harbors, aerial raiding bases for sea attacks, and transoceanic aerial patrol service—by these uses of air-craft might perhaps be given the vital blow to the German submarine.

Why not, though, airplane bases at sea? And if at sea, why not all the way across the Atlantic? Why not airplane stations in and near harbors, where the craft can be despatched, received, overhauled, and refitted? Why not, in other words, not only a maximum of aerial coast defense but an open sea lane, patrolled day and night by planes?

Such a cross-sea lane is not as yet needed, perhaps. But the lane could be extended from English and continental shores as far as required to give ample protection within the operating zone of the German submarines.

What I propose here is the adaptation of a German idea - that of the "mother ship" for submersibles—to the airplane, at the same time retaining the protective and repair value for submarines and destroyers embodied in the Teuton ship: with the further expansion of the use of these double vessels on the open sea where they can be utilized as starting and receiving points for aerial patrols, for light ships, for relay wireless stations, for defense points against torpedo raids.

Take then, by way of summary of this plan, two separate hulls, so connected by superstructure as to form one boat with two bottoms. Two sets of engines and double rudders would provide for the handling of this double-hull ship.

The superstructure above these hulls may be most briefly described as a "platform," a deck of extreme width and length, from which air craft could be launched and, in some instances, received.

Between the hulls is a natural harbor, the water of which is made calm by the lowering of end gates to keep out the waves. From beneath the upper "platform," or deck, hangs a false deck which may be lowered into the water. This lowered deck and the end gates form, with the hulls, a huge tank into which hydro-airplanes can descend, and by means of which they may be elevated to the upper deck for overhauling. Similarly submersibles, destroyers, and small water craft can be driven into this protective space and taken out of water for repairs and scraping.

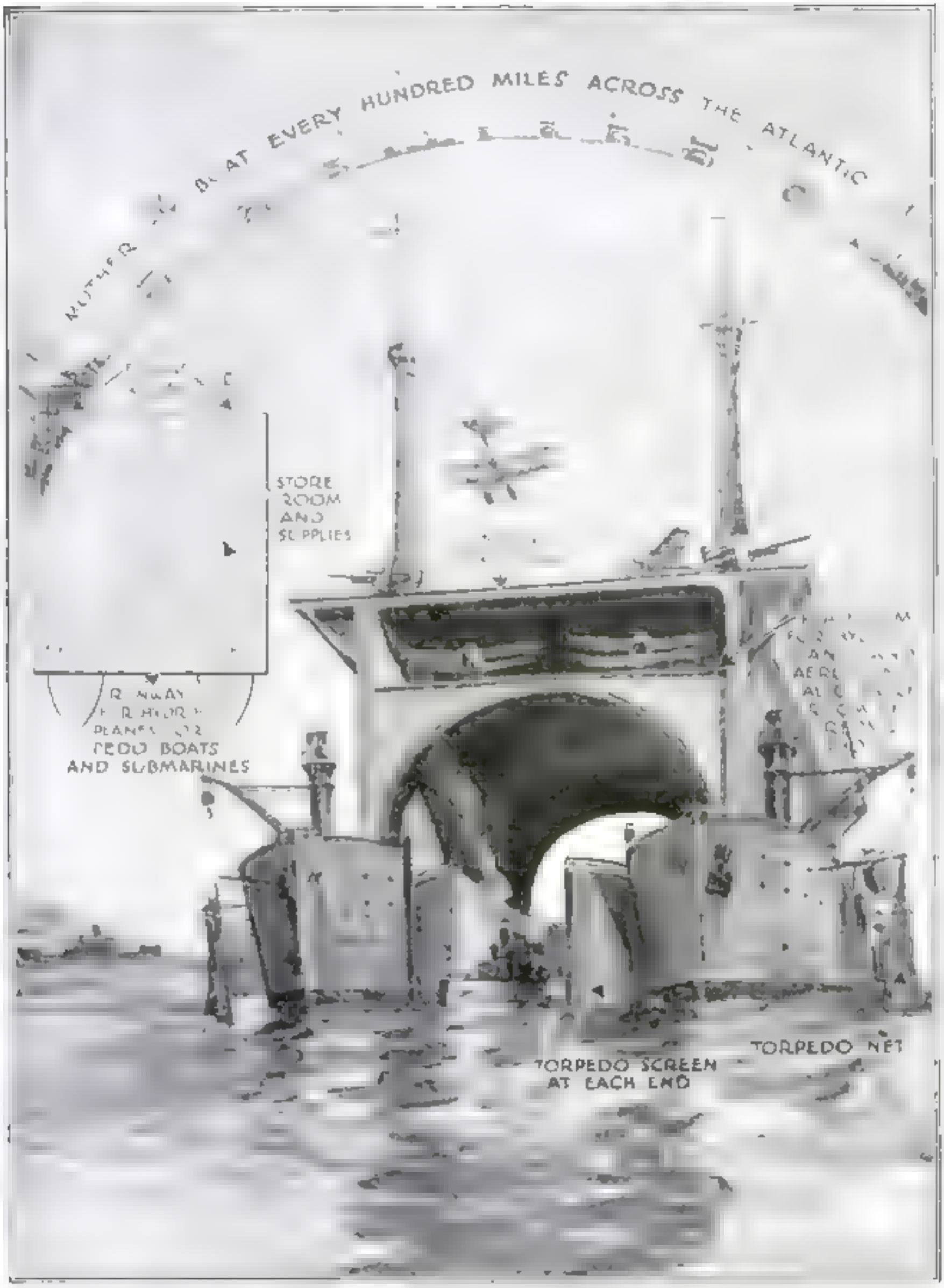
The stationing of such "mother ships" at intervals of, say, a hundred miles all the way across the Atlantic would provide an open lane for transports and merchantmen. One hundred miles an hour may be given as an average speed, all weathers and models considered, for an airplane. These stations, then, would be but an hour apart by air route. At no time would any airplane patrolling from one station to another be more than half an hour's ride from another.

Constant patrolling by aerial routes from one station to another would keep the sea clear of under-water raiders. Communication would be so rapid, discernment so easy, that the submarine would be less deadly than it has proven to be. The air could be kept filled with the flying scouts, passing from station to station, one hundred miles and return, with communication maintained by wireless, not only between airplane and floating harbor, but between the stations themselves.

Once a periscope has been sighted anywhere within radius of the sea lane, general knowledge of it is known; and from the "mother ships" debouch a fleet of destroyers.

For the protection of the "mother ships" torpedo nets would be provided. Besides there are the accompanying destroyers, the "mother ship's" own heavy artillery and munitions. It would be a rash submersible navigator who would invade the precincts of such a lane.

Patrolling the Ocean with Sea Planes



What a "Mother Ship," as Suggested in Our Article, Would Look Like

In the accompanying article the writer propounds a scheme for placing one of these vessels at intervals of a hundred miles, all the way across the Atlantic. They would be fully equipped with spare parts and supplies for airplanes and submarines. They would also carry wireless apparatus, and would, in fact, be fully equipped naval bases in miniature. They would repair seacraft and airplanes and would relay wireless messages being official stations. They themselves would be protected by torpedo nets, heavy guns, and fleets of destroyers, for which they would form a base. In fact, their use in every direction is limited only by their size

This bicycle track, properly banked and oiled, was designed and built by a number of resourceful Los Angeles boys

"Let's Build a Bicycle Track"—And They Did

AN ingenious crowd of boys in Los Angeles have made a very good bicycle track on a vacant lot. One of the boys' fathers was a contractor and this lad superintended operations. The track was first laid out with chalk and stakes, and then the bunch turned to and did the digging. They soon had it banked up and smoothed off. Then they watered it, and oiled it with waste "slag" oil which they carried from a nearby oil well in tin cans.

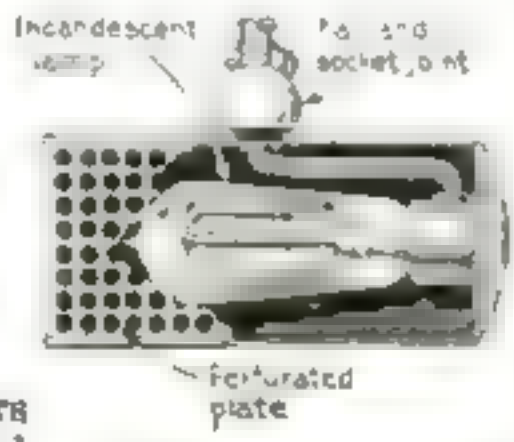
How to Keep the Windshield Clear by Heat

TWO Chicago inventors have recently patented a device for keeping the windshield of an automobile or the window glass in front of a trolley motorman clear by means of an electric incandescent bulb. The heat generated by this bulb is sufficient to heat the glass so that snow, sleet, moisture or ice will at once be turned into water and run off or dry off, thereby enabling the man behind it to see through without difficulty.

Although the same in principle, the device for the automobile differs slightly from that for the trolley car. In each there is a semi-cylindrical casing enclosing the incandescent lamp and a bracket supporting the casing to enable it to be swung up out of the way when not in use. The uncylindrical portion of the casing consists of a flat perforated metal surface which is in contact with the glass of the windshield or car window.

The automobile unit has a bracket which is slipped over the wood or metal edging on the top glass of the windshield, in the car device, the bracket arm is pivoted inside the bottom of a box with a hinged door so that the arm and casing enclosing the lamp may be swung about its pivot into the box and the door closed. In each case, small coil springs are employed to keep the perforated metal part of the casing in contact with the glass so that the heat radiated by the bulb and reflected by the back of the casing cannot pass off without first going through the glass and heating it sufficiently to dry it.

Every automobilist knows how uncomfortable, and even dangerous, a frosted or misty windshield is, and any device that will obviate these conditions is welcome. This device has an advantage over scrapers and cleaners in that it requires no repeated manipulation or attention.



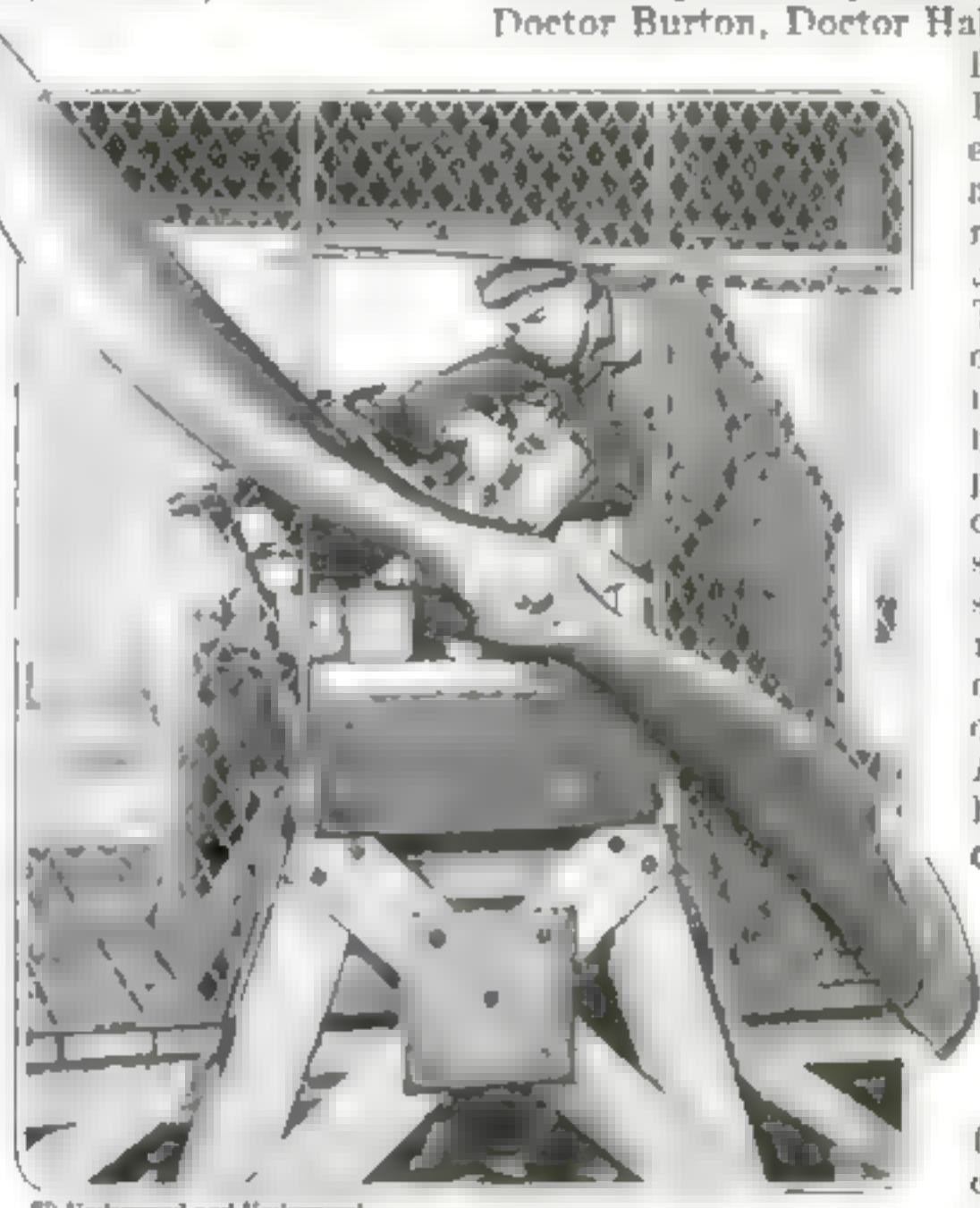
An incandescent lamp in a reflector melts the ice and moisture off the windshield, giving clear vision

Caging the Airplane Propeller in Case He Gets Too Wild

THE propeller of a modern flying machine rotates at the rate of about fifteen hundred revolutions a minute. It is mounted directly on the shaft of the powerful motor by which it is driven. When the engine is started, the roar is deafening—so much so that in testing an airplanepower plant before it is mounted in a machine, the men who conduct the test must wear earprotectors, similar to those used by the crews of our big coast defense guns.

But all this does not explain the cage in which the propeller is revolved during the test. What is the reason for that?

The cage is a safety device. It protects the men who are conducting the operation. Flywheels of steam engines sometimes burst when they spin too fast. Why? Because of the centrifugal force. The greater the speed, the greater is the centrifugal force. A propeller which revolves at the rate of fourteen hundred revolutions a minute might fly off, even though the utmost precautions are taken to fasten it securely to the shaft. And if it ever flew off—? A bursting flywheel has many a time wrecked an engine-house as effectively as a high-explosive shell, and a wild airplane propeller would be most unhealthy for anything it encountered upon its wanderings. The eye extends along the edge of the testing platform.



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Airplane propellers occasionally have their own ideas about flying. This cage discourages them

Kerosene Can Be "Cracked" to Produce Gasoline

IF crude oil yields different liquids when heated to different temperatures, what would happen if the separate distillates were treated again in the same way? The experiment has been carried out with astonishing results by different chemists—Doctor Burton, Doctor Hall, and Doctor Rittman. Kerosene, for example, can actually be made to give up gasoline. The process is called "cracking." Imagine before you two piles of stones of different sizes. The small stone-pile represents gasoline, the large one kerosene. A man with a hammer can obviously crack the larger stones into pieces equal in size to those of the first pile. The chemical equivalent of this seems to take place in cracking kerosene. Since kerosene is so difficult to dispose of, why not crack it and get enough gasoline for the four million automobiles which will be in use this year. Cracking processes actually furnished seven and one-half per cent. of the total gasoline production last year.

In 1918, at least one-fifth of the three billion gallons to be produced will be made by cracking. Their value would pay for ten superdreadnoughts.

Had it not been for the invention and utilization of cracking processes, gasoline would cost more than it does. During the year 1917, approximately 600,000,000 gallons of cracked gasoline were produced.

Seen from Above, This Picture Would Look Different

Those daredevil movie actors—with a mattress and springboard

A SCENE like the above, wherein two Vitagraph comedians leap fifteen feet across an alley, cannot fail to give us a slight gasp. Well, how do they do it? Listen.

If you were up above the explanation would stare you in the face. For these laughable gentlemen would not be half so laughable if they were making the jump with nothing but their own two legs. As a matter of fact they are working under ideal conditions, precisely as if they were in a gymnasium. On one side is a springboard; on the other a spring mattress. It's a cheap thrill at only fifteen feet!

Whale's Tail-Bones Made Into an Attractive Sign

THE Coronado Islands, off the coast of Lower California, not far from San Diego, have always attracted tourists because of the great numbers of whales, sea elephants, sea lions, and other large aquatic creatures, that disport themselves off the rocky shores. Taking advantage of these natural conditions, a a boat company of San Diego attracts the attention of tourists to its docks by means of a sign painted on the great tail-bones of a defunct whale.

The broad flat bone forming the end of the tail makes the sign board, while the three other vertebrae form a convenient stand to support it.

It is doubtful if any sign more instantly commands the attention. The bones were brought in by one of the company's boats from the surrounding beaches.

We Are Presenting Germany with Two Hundred Aviators a Year

THE Germans claim to have brought down a thousand Allied airplanes during the past twelve months. It is estimated that with better physical training a fifth of these need not have been lost. As the training and equipment of these men would cost about $3,500,000, according to Alan R. Hawley, President of the Aero Club of America, apart from the inestimable value of the men themselves, it would seem that we are paying rather dear for lack of attention to physical fitness. The men will never admit "staleness" though, for any reason.

This curious advertising sign is made from the tail-bones of a whale. Compare the glove

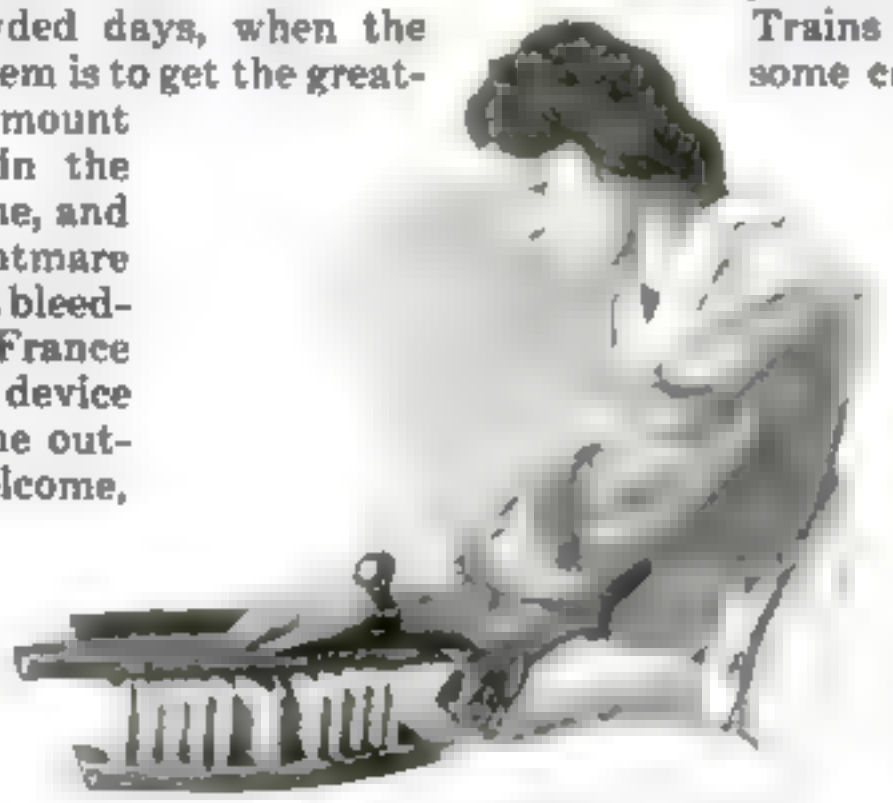
Two Boards Studded With Pins Make Bandage Folder

RED CROSS workers are greatly interested in a device for folding bandages, which has been invented by Edward J. Seeber, of Rochester, N. Y., and which is so simple that it may be made by anyone with the tools found in practically every household. The inventor has donated the free use of his invention to Red Cross workers everywhere.

The contrivance is intended for folding the eighty-one-inch bandages which form part of the emergency kit of every soldier sent to the trenches.

It is made as follows: An upright board, fourteen inches long, fastened to a horizontal base, has a series of ten three-inch pins, five on each side of a center bracket. The strip of bandage is placed over these pins, with the center of the strip over the bracket. Then the follower, a narrow board, about nineteen inches long, with twelve pins, arranged in such manner that they will dovetail with the pins of the upright backboard, is employed to press down the strip of bandage between the pins of the backboard, so as to pleat it, accordion fashion. Two hatpins temporarily fasten the folded bandage until the two halves are stitched and ready to be wrapped and sent out.

In these crowded days, when the compelling problem is to get the greatest possible amount of work done in the least possible time, and the dreadful nightmare of our own boys bleeding in far-off France urges us on, any device that increases the output is doubly welcome, and this, being of such simple construction, will recommend itself to everyone interested.



A home-made bandage-folder for Red Cross workers. It is simple and cheap

No wonder the train was twelve hours late, or that the trainmen had suffered considerable hardship

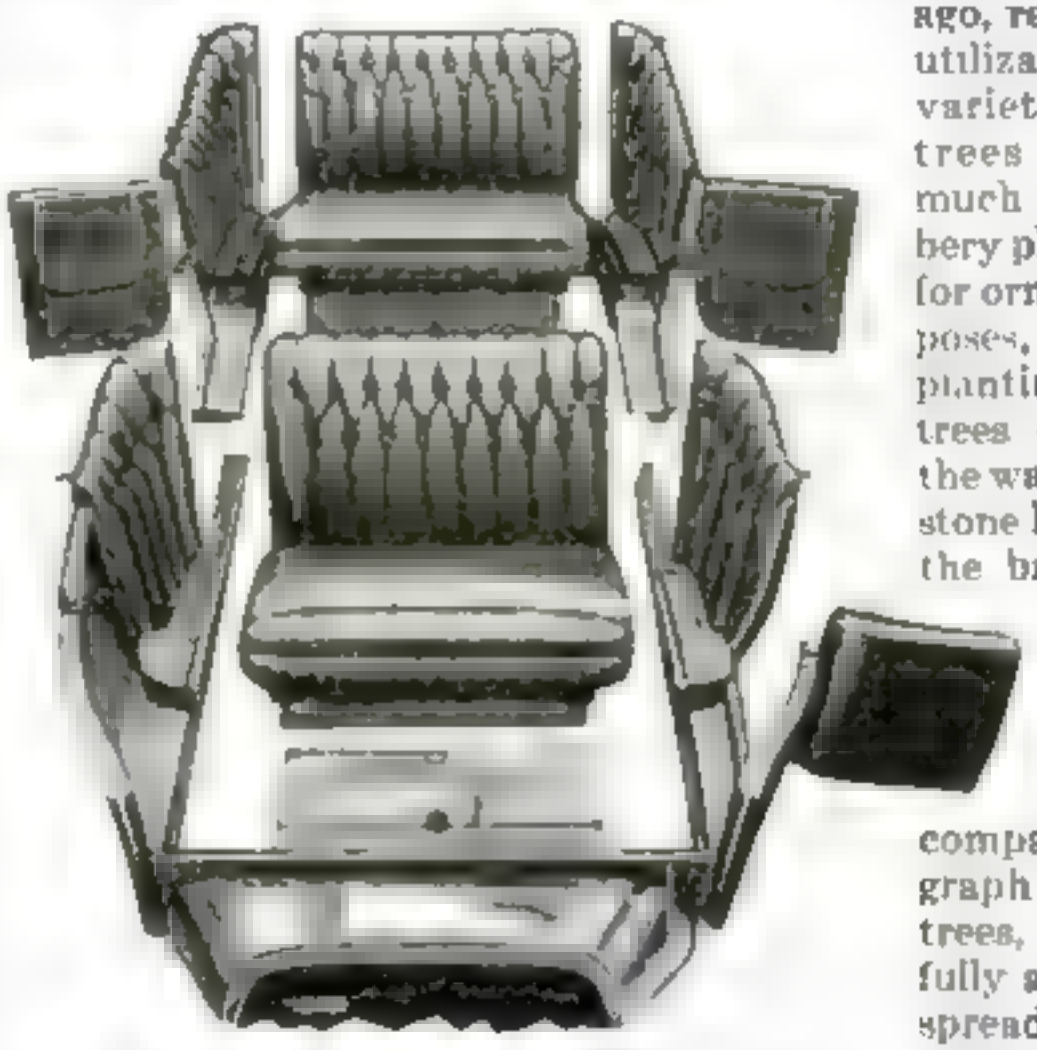
Like a Trip to the North Pole Is Rail-Roading in a Blizzard

WHAT the terrific and widespread blizzards which raged through the middle western and eastern parts of the United States in the first week of January meant in handicapping the railroads and depriving large cities of coal and food is shown by the accompanying picture. Trains were snowed in and in some cases it took several days to dig them out. The trainmen suffered from cold and exposure to the driving snow and sleet, and frozen hands or feet were common. The accompanying picture is that of a locomotive of the "Soo" line, which arrived in Chicago after a fierce battle with snow and ice, which caused a delay of twelve hours in its arrival. One would imagine that it had been dug out of a drift.

Automobile Body That Packs Within Chassis Space

YOU have seen the advertisement pictures of knock-down bungalows and small cruising launches? The various parts are first put together, then marked, taken down, and finally packed one inside the other for shipment.

The same idea has been applied to reduce the cost of shipping automobile bodies by packing them in fifty per cent of their usual space. What is more a body can be converted into a two-seater, a four-seater or a delivery car with a small load-carrying box at the rear.



Sectional automobile body which can be assembled by the purchaser or dealer

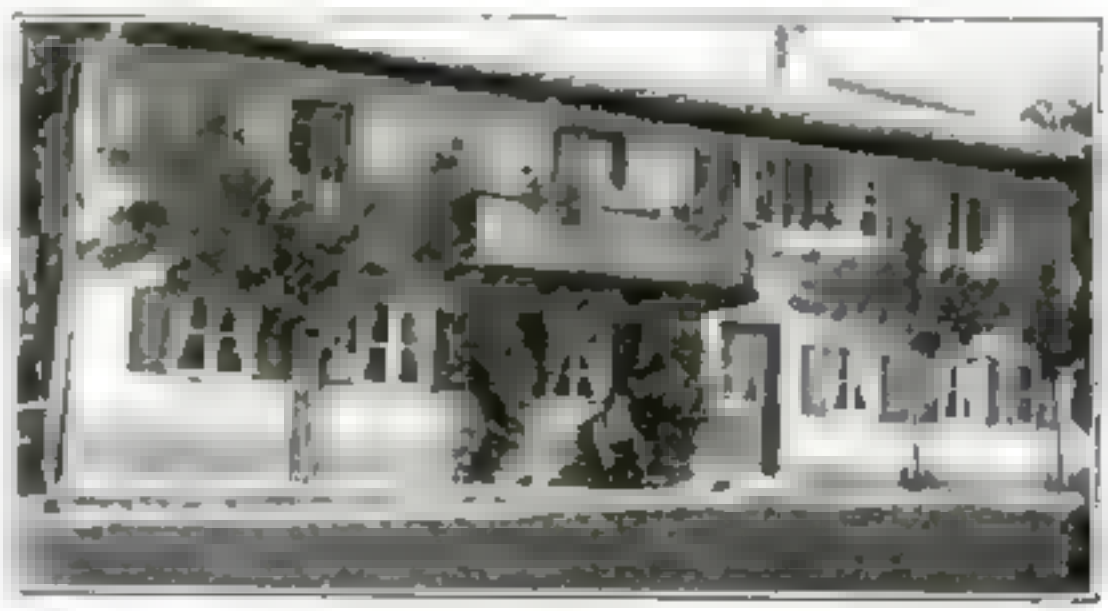
In brief, the body consists of two side sills which are mounted directly on the car frame when assembled, and separate cab side portions, floor-boards, doors, rear, side, and end parts, the vertical and horizontal parts of seats, and even parts of the cowl and engine hood sides and top.

The various parts into which a body may be divided are shown in the accompanying sketch. When put together, the various parts are rigidly held in place by means of small bolts with countersunk heads, so that the entire body is a homogeneous unit which can be painted and varnished according to the individual taste of the purchaser. The convertible feature of the body is made possible by leaving off some parts and inserting others in their places to give two or four seats or a panel or box type delivery body as shown.

Use Fruit Trees Instead of Shade Trees or Even Ivy

A CONSERVATION of land space movement, in Germany, some time ago, resulted in the utilization of dwarf varieties of fruit trees instead of much of the shrubbery planted merely for ornamental purposes, and in the planting of small trees close against the walls of brick or stone houses so that the branches could be trained over the walls in the manner of ivy.

The accompanying photograph shows pear trees, pruned carefully and trained to spread out over the walls just like vines. The practice is now common in hard-pressed Germany and is likely to find favor in this country. Pear, plum, and other fruit trees are thus trained over housewalls, fences and garden partitions so that not an inch of ground is wasted. In this way, too, the trees are prevented from throwing too much shade over other growing things in their vicinity, and the appearance of the houses is, in addition, very considerably enhanced.



Pear trees trained to spread out over the walls of a house like ivy vines both for pleasure and for profit

A Floral Tank Struck a Warlike Note at the Pasadena Carnival

AT the annual Tournament of Roses in Pasadena, Cal., a marked change in the character of the floral decorations and floats was noticeable. Some of the floats in the parade introduced a warlike note. One of the most interesting was a facsimile of a British tank. It was thirty feet long, and fifteen feet high. The body of the tank was of smilax, the caterpillar treads were of gray acacia and the cleats were white desert holly.

Representation of a British Tank, made of flowers and smilax at the Pasadena Tournament of Roses

An Industrious Whittler Made This Endless Chain Out of a Board

THE chain shown in the picture constitutes a remarkable monument to the patience, industry and skill of Nicholas Burton, deceased, of DuBois, Pa. Burton conceived the idea of making an endless chain out of a single board. He selected a board twelve feet long, seventeen and a half inches wide and seven-eighths of an inch thick, and, with no other tool but his jack knife, carved this board into an endless chain of 4,522 links, with a total length of 305 feet. The links were each one and one-quarter inch long and seven-eighths of an inch wide. It took Mr. Burton just one year to complete this very remarkable and painstaking piece of work, each link of which is perfect.

A jack-knife and a man's skill and patience carved this endless chain from a board

Have Your Collar Stiffened Once for All and Eat the Starch You Save

THE separate starched collar was invented about ninety-two years ago by the wife of a blacksmith of Troy, N. Y., who made one for her husband. Since then it has grown in popularity until there is probably nobody who has not worn a starched collar at some time or other. Now its popularity is on the decline again, partly on the score of comfort, and partly as a result of the war.

The crux of the matter does not lie with the collar itself, though that is made from material which is useful for bandages. It's the starch that is to be saved—valuable foodstuff that ought not to be wasted on collars.

A permanently stiffened collar is being introduced which is not celluloid, but is a regular fabric collar treated with a kind of varnish that makes it possible to clean it under the tap or with a damp cloth. Automobilists should be among those who appreciate this new fabric, for, in spite of road dust, it is always possible to "feel clean" in a clean collar. A collar of this kind will last from two weeks to a month.

It's Raining, But the Glass Umbrella Keeps the Record Book Dry

THE numbers of the freight cars leaving or entering a depot, have to be recorded rain or shine. How to enter figures in a book during wet weather without blurring the pages has been a problem.

Now comes the "book umbrella," a small, oblong glass box, open at the underside to allow the number-taker to insert his hand. Of course, the book is held inside the protecting glass. Clips are provided at the top and bottom to keep the book open at the desired page.

The case, six inches square, is fitted with a strap which can be suspended from the clerk's shoulder. A larger sized "umbrella," made to hold loose, flat sheets, is also obtainable. For night use, an electric light can be affixed to the upper end of the box, and in addition to enabling the user to see to write, it answers the purpose of a lantern to see the necessary data written on the car and to get about the yard.

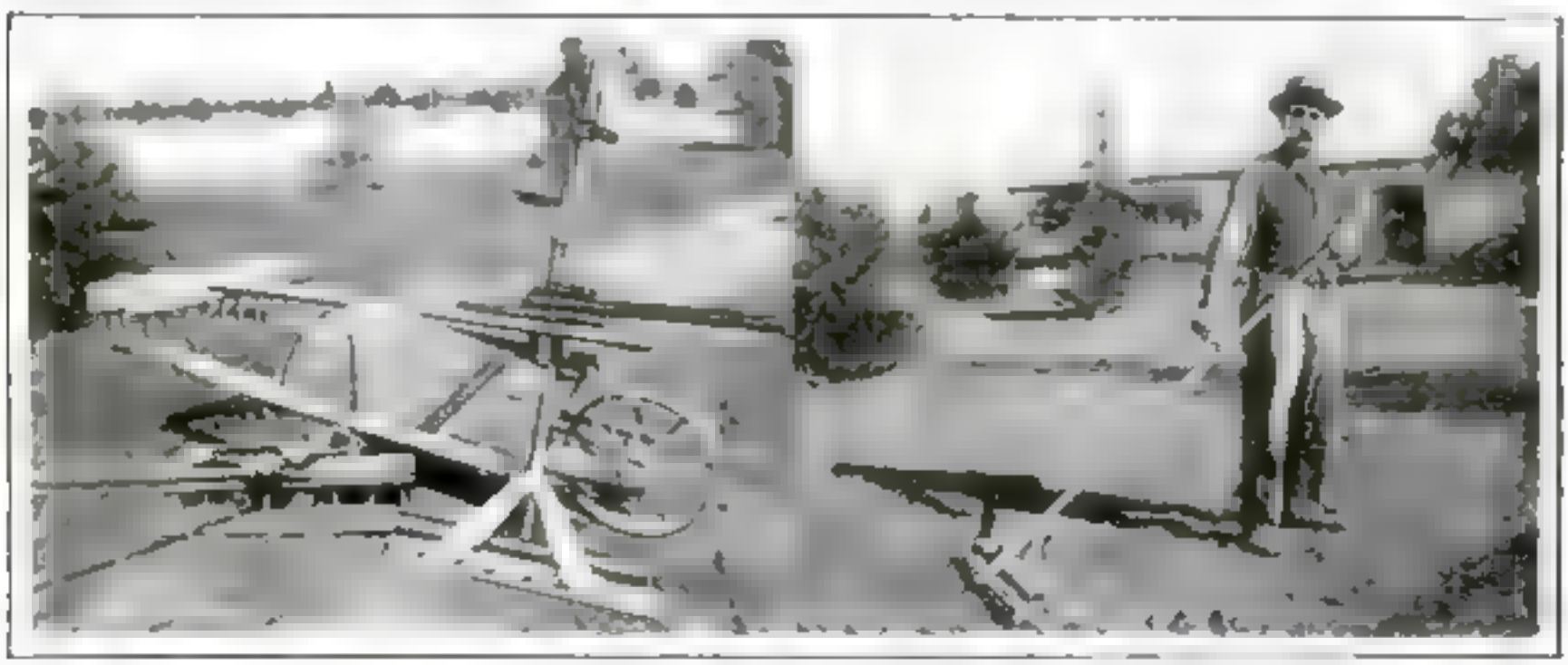
The case is light, strong and durable. Clips hold the book open as required

These Home-Made Tools Save the Cost and Keep of a Horse

WITH the home-made garden tools shown in the accompanying illustrations a man at San Jacinto, California, cultivates five acres of ground without the aid of a horse. On his grounds ornamental shrubs grow. A horse could not be driven close without injuring them. With a similar set of tools a small fruit orchard is also kept in condition.

The cultivator consists of a number of spikes driven into a three-foot piece of pine, and having their heads flattened to make a cutting edge. The top of the tool is reinforced with another piece of wood and a five-foot handle is fitted. A piece of iron gives the necessary weight.

A rake similar to the one described, but with a strip of thin steel cut from a saw blade and soldered to the flattened heads of the spikes, is used as a weed cutter. The cutting blade is inserted from two to three inches below the surface of the ground and cuts off the weeds from their roots.

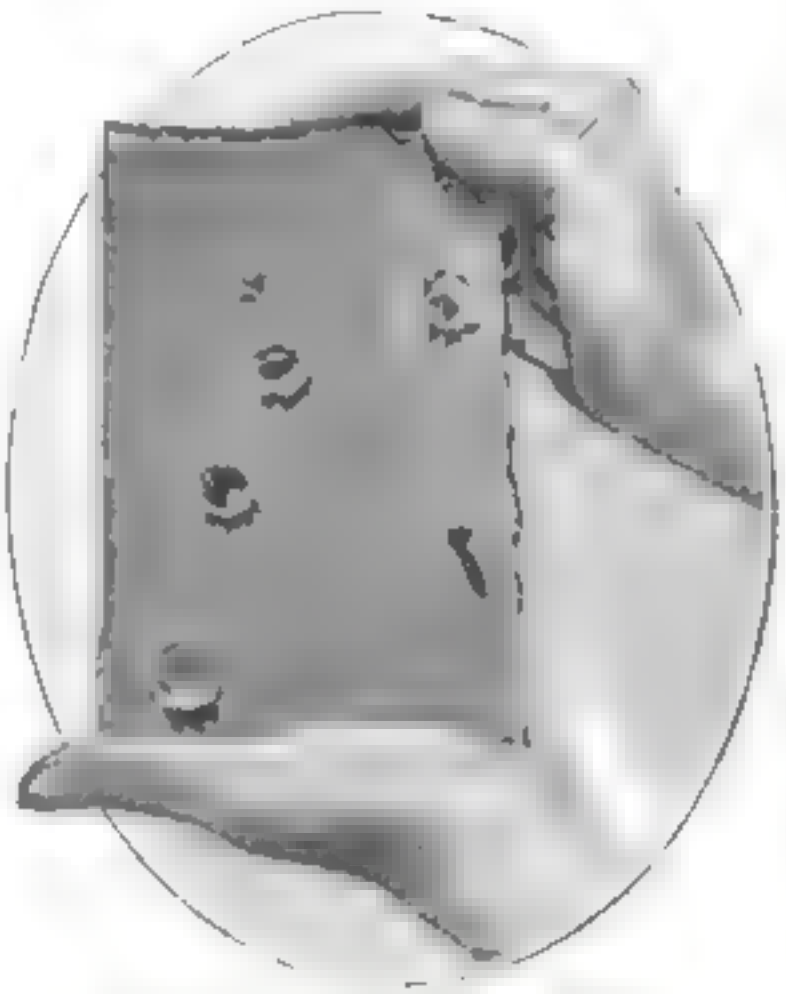


The above set of home-made cultivating tools enables one man to cultivate five acres of land without the necessity of keeping a horse, which would spoil his ornamental shrubs

Bullets That Shoot Through Steel

Medieval armor was revived, but it now bids fair to become once more obsolete

A BRITISH sniper lay behind his shield of quarter-inch hardened steel at the Ypres salient and smiled when a bullet from a vigilant German sniper crashed against the protection. He knew that nothing less than a couple of shells from some far-off field gun could bother him. When the next shot came, the smile faded from his lips. After dark he crawled painfully back to his trench-line, shot through the left shoulder. In the shield, which would turn a bullet at the very muzzle, there was a neat round hole, less than one-quarter of an inch in diameter and therefore smaller than the service bullet of the German rifle. From the shoulder the surgeons took the missile, a bullet made of solid steel, boat-shaped, with sharp point and tapered tail, and harder than glass. From other bullets of the sort, fired by the Germans for special occasions, the British were able to reconstruct the whole bullet.



Effect of Armor-Piercing Bullets

The revival of medieval armor as a protective device has become one of the interesting sidelights of the present war. The first serious application was the steel shrapnel helmets and since that time armor has been used more and more. Now, however, means have been discovered to pierce it and it would seem that it is about due to be once more relegated to the limbo of obsolete things. What will the next revival be?

Inside the German bullet, with its customary mild steel jacket—instead of the copper-nickel jacket used by the Americans and British for the same purpose—and inside a coating of lead, there lay a miniature bullet of steel, which the surgeons took from the sniper's shoulder and which had gone through the supposed bullet-proof shield.

Fired from the Mauser rifle of the German, the mild steel jacket and the lead covering of the steel bullet inside, yielded enough to take the rifling of the barrel, and the bullet flew through the air like any other bullet. When it struck steel, the leaden covering, and the thin steel jacket supported the steel point of the bullet within for a short instant, then they spattered into a spray of molten lead and fragments of jacket, and the steel bullet traveled on alone through the steel plate.

This is the principle of the armor-piercing bullet that is coming to be so common among the fighting armies of the world.

The corresponding American bullet is the Clay, invented by Captain W. L. Clay of our Ordnance Department. It is superior to any of the armor piercers made abroad. Through the construction of its point it will not glance off even the most inclined hardened steel surfaces, for armor surfaces are sloped when possible, to avoid a direct hit on the armor, and to make the bullet glance off harmlessly.

The Clay bullet has the jacket cut away for the last eighth of an inch at the point, exposing the soft lead. This in turn smashes down on striking, changing the shape of the point and making the bullet "bite" on the hard, inclined surface. Then the hard steel bullet within comes smashing through, while the lead and the jacket fly off in spray and fragments, their work done. The actual killing or wounding is done, of course, by the little steel bullet inside of the ordinary one.

Here is a group of English railroad employees worshipping the deity, Tea, under unusual circumstances

If You Work Hard, Eat More Pancakes

IT is a common mistake to suppose that to get the necessary strength to do hard manual labor, a heavy meat diet is necessary. This is far from correct. Muscular labor does not materially affect the demand for minerals and proteins, but rather for starches, fats and sugars. Therefore any additional wastage through muscular effort could be much better repaired by pancakes and sirup than by roast beef, for as much moisture and heat are wasted as tissue, so it is fuel that is required.

England Must Have Its Tea, Even If It Is Wartime

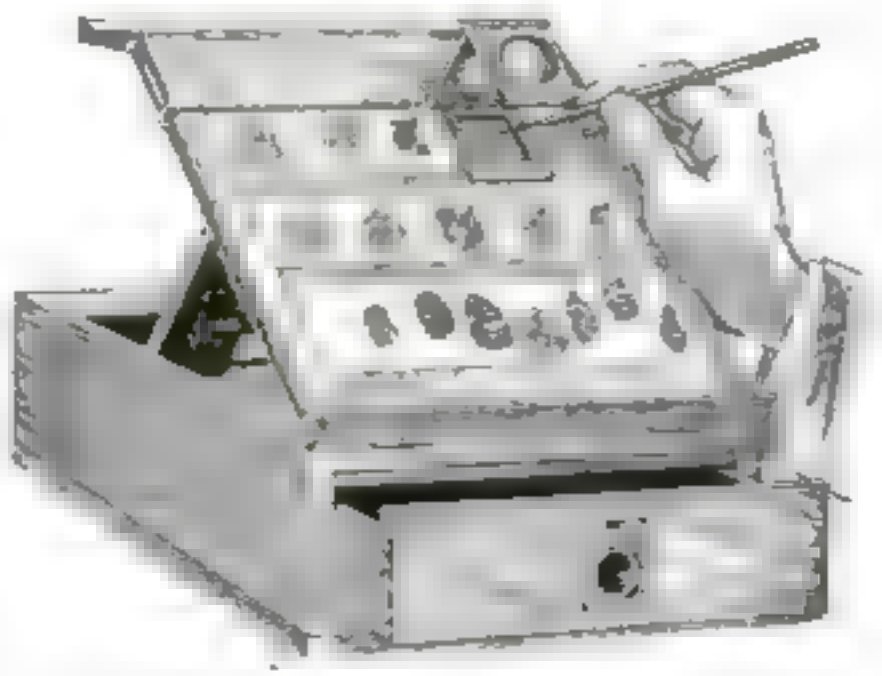
THERE are tea-parties and tea-parties. Some, like the Boston variety, have become historically famous; others have not. The tea-party in the picture, with its unconventional setting and sitting, is not exactly a "pink tea" patronized by the upper-ten-dom. It is really an interesting picture of wartime England. The women in the group are railroad employees in London. Chilled to the bone by the penetrating cold of an unusually severe winter day, these hard-working young women gathered in a secluded corner during a lull in their work, and warmed themselves and gained new energy by sipping piping hot tea.

Tea seems to be a *sine qua non* with our English cousins. War or no war, teatime is sacred. Apparently, judging by the war pictures, even the Tommies at the front religiously observe it—and at least it is stimulating.

How Finger Prints Are Studied With a Handy Portable Desk

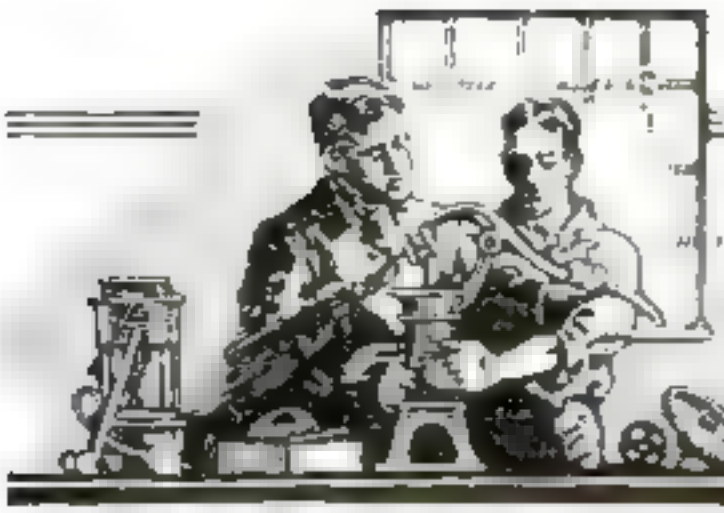
FINGER prints of criminals are photographed and filed away for reference. A filing cabinet which makes it easy to handle the photographs has a board hinged to the top which can be set at any desired angle. A place is provided for a magnifying glass through which the finger prints may be studied. A mounting board which is ruled into spaces for right and left hand prints makes the examination of the photographs very simple.

When not in use, the board drops down into the top of the case. Under the board is a drawer which provides the necessary space for filing the photographs.



This filing cabinet for finger prints saves much time and trouble for investigators

This filing system makes it convenient to classify the thousands of prints by various groups and sections, so that any particular set or sets can be obtained immediately for study or comparison with others. The whole thing is compact and convenient.



FOR PRACTICAL WORKERS

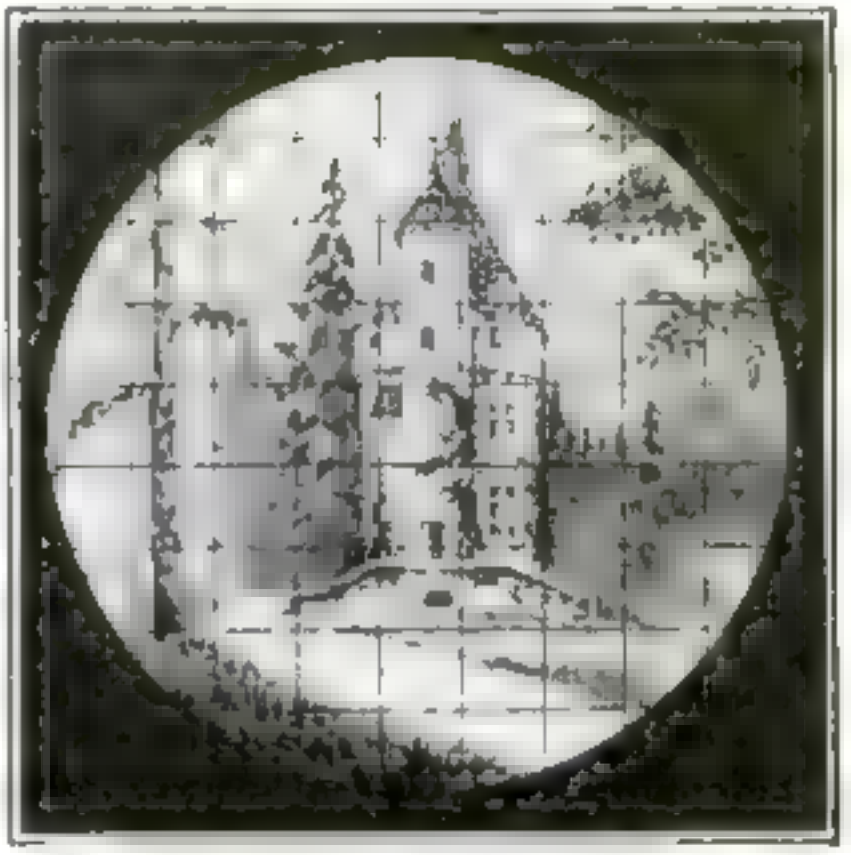
A Chemical Preparation to Preserve Cut Flowers

IF a little saltpeter, or carbonate of soda, is added to the water in which flowers are left standing, they can be kept comparatively fresh for more than two weeks. Another method is to add a small amount of ammonium chloride, or camphor, to the water. The presence of one of these substances stimulates the plant cells and acts in opposition to germ growth. Flowers that have wilted can be revived for a time if the stems are inserted in a solution of weak camphor water.—HERMAN NEUHAUS.

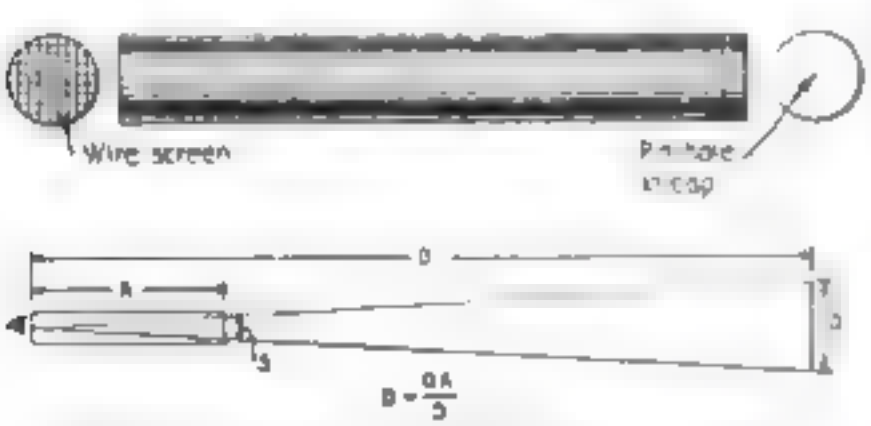
Simple Construction of a Useful Range Finder

ONE of the simplest range finders ever devised consists of a short tube, one end closed by a cap pierced with a pin-hole, the other end covered with a wire screen of square meshes.

The manipulation is as simple as the construction of the instrument. With the eye close to the pin-hole, look through the tube at some distant object of known length (say a distant freight car). The wire mesh will stand out clearly in the field of view, and the number of spaces which are outlined against the object may be readily counted off. (In the accompanying illustration the tower is six spaces high.) It is evident that the object is farther from the peep-hole than the wire mesh, in the same ratio as the length of the object is to the aggregate width of screen openings which enclose it. (See preceding diagram). Suppose a 50-ft. freight car is covered by four spaces of a 20-wire-to-the-inch screen. The distance to the car is obtained by multiplying the length of the range finder by the ratio of 50 ft. to 4/20 of an inch, i. e., by the ratio of 3000 to 1. If the range finder is 2 ft. in length, the car is two thousand yards distant.



In looking through the range finder the object is covered with the mesh screen



The tube with its peep hole and screen covered end and formula to compute distances

It is plain that this type of range finder is restricted to use with objects of a known dimension. The height of a distant man may be taken as 70-in., with a probable resulting error of less than 5 per cent. Objects of a fairly standard length should be chosen. Recording to fifths of a screen space is comparatively easy. Even a novice may determine ranges with an error not exceeding 10 per cent.

A Self-Contained Hot Water Foot Warmer

IT has been shown that a certain combination of salts brings about the generation of heat. By applying this

Pouring the salts into water to make a mixture that produces and holds heat

chemical phenomenon, a cheap and efficient warming bottle may be formed. First of all mix together sodium acetate and sodium hyposulphate in water, using one part of the former to nine parts of the latter salt. There should be a sufficient quantity of these materials to fill the earthenware bottle three parts full. The vessel should now be loosely stoppered and placed either in hot water or in an oven until the salts have completely dissolved. For many hours after this the bottle will radiate considerable heat. To renew the warmth-giving properties, it is only necessary to give the bottle a good shaking.—S. LEONARD BASTIN.

Circulating Air in a Room to Warm It Evenly

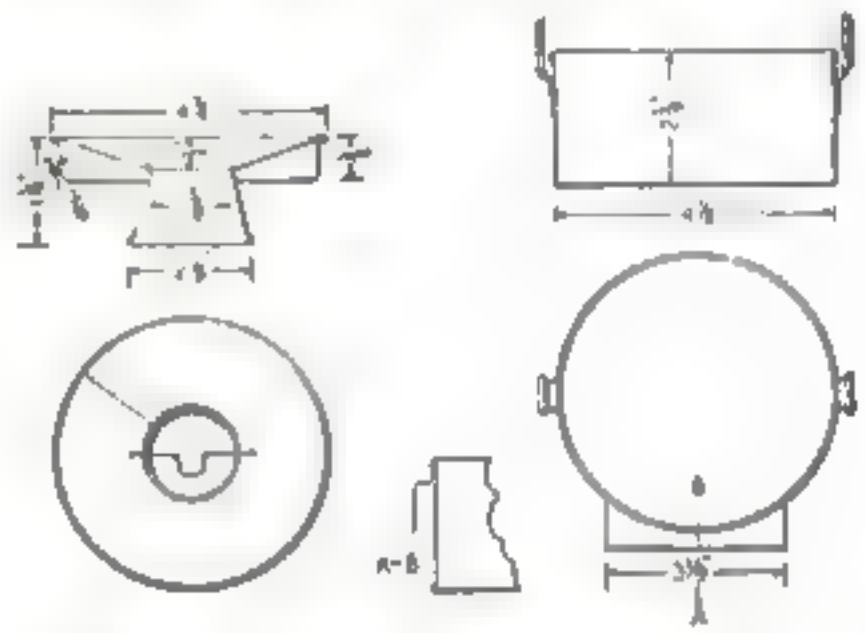
THE temperature of a heated room is several degrees warmer at the ceiling than at the floor. To equalize the temperature, it is necessary for the air to be in circulation. This may be accomplished with an electric fan, but to prevent any unnecessary draughts, the blast from a fan should be confined. As the air must be driven from the floor to the ceiling, place the fan in one corner of the room in such a position that it will drive the air upwards. To keep the air confined, make a cardboard tube about 6 in. in diameter to carry the air up and across the ceiling to the opposite corner of the room. This will take the cold air from the floor and force it out at the ceiling level. Naturally the air currents are forced from a lower to a higher level, thus equalizing the temperature. JOHN T. FORD.

Inward Flaring Cover for an Oil and Plumbago Can

THE photograph and drawings illustrate a very handy "dope" can which is convenient in many ways to the mechanic. The mixture, more commonly known as "dope," being a combination of plumbago and oils, is used on thread joints to prevent them from rusting and being difficult to remove.

You can't spill everything from this can

Due to the construction of the cap or cover, the can, if overturned or upset, will always retain a goodly portion of its contents. Around the opening or mouth a piece of wire is bent and soldered in the form of a loop. This affords a good swipe for the brush, cleaning off any surplus which may adhere to the bristles. It keeps the mouth of the can clean as the oil surplus drops at once into the middle of the opening. The square shouldered



Details of the parts for making the can with its flaring cover to hold the lubricant

portion on one side will be found very convenient for catching and holding the can on any projection which may be near the work requiring the application of the dope.—F. W. BENTLEY, JR.

Portable Brush Burner Carried on a Truck

THE accompanying illustration shows a labor-saving device which is used by fruit growers in a western valley. It is a portable brush burner used mostly in young orchards where there is less danger of damaging the overhanging branches. In older orchards, where the trees occupy a larger space, it is customary to gather and haul the brush out of the orchard, to be burned. But this simple brush burner is a labor-saver in the young orchard where little pruning is needed. An ordinary brush pile burned on the ground spoils vegetation and the ashes resulting from the fire have little value if left in a heap. The burner keeps the heat from the ground and the ashes may be strewn where needed.

The sheet metal is curved to hold the brush and is supported on the wagon truck with metal pieces

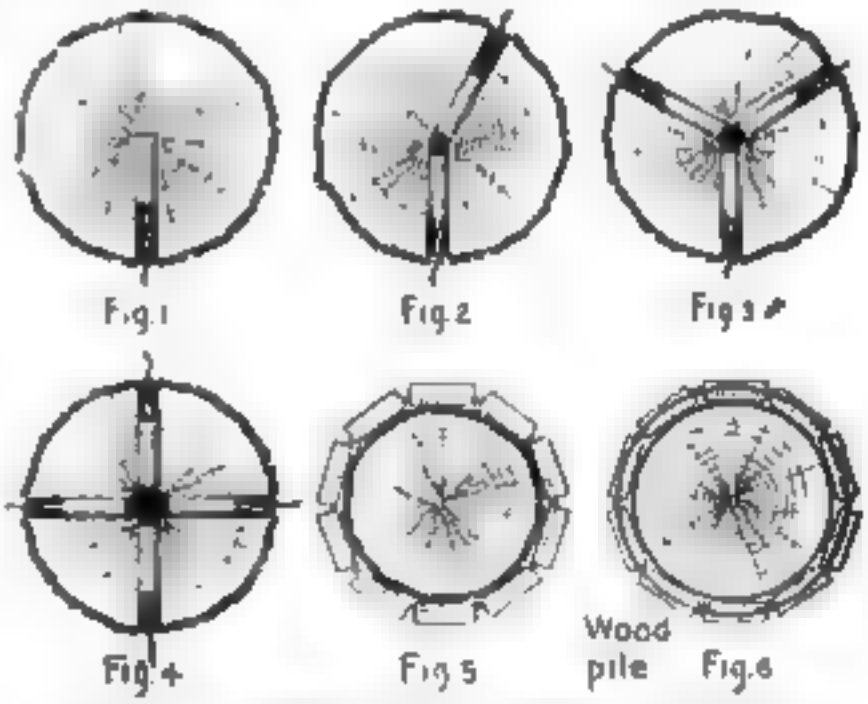
It consists of a steel plate bent in a U-shape and supported on a truck with curved angle iron held above the woodwork by metal braces. It saves handling the brush several times, as the men can throw the brush on to the fire and save two haulings.

It costs about $2.50 an acre to handle brush with this device, and where a large acreage is to be cleared, this is less than it costs to use a team and men hauling it out of the orchard. —EARLE W. GAGE.

It's Easy to Blast Trees or Timbers with Dynamite

IT is a very simple matter to blast almost any kind of timber work with the aid of dynamite, without danger, if certain simple rules are followed. To blast trees or timbers a charge of ½ lb. per square foot of sectional area is placed in holes in the same cross-section, which will be sufficient to cut off trees and round or square timbers of ordinary proportions. The holes back of the cartridges are filled with clay and tamped. One stick placed as shown in Fig. 1 will usually be sufficient to bring down a tree of less than 13 in. in diameter, while two sticks placed as shown in Fig. 2 will be enough for a tree under 19 in. in diameter. Three sticks placed as in Fig. 3 will be required for a tree or timber under 23 in., and four sticks placed as in Fig. 4 will bring down a tree 27 in. in diameter, or less. The charges should be fired simultaneously, but if firing must be done by time fuse it is often advisable to place one charge and explode it; then place the second charge, and explode it; and so on.

If a timber is not over 12 in. in diameter and no boring tools are at hand it may be readily cut down by encircling it

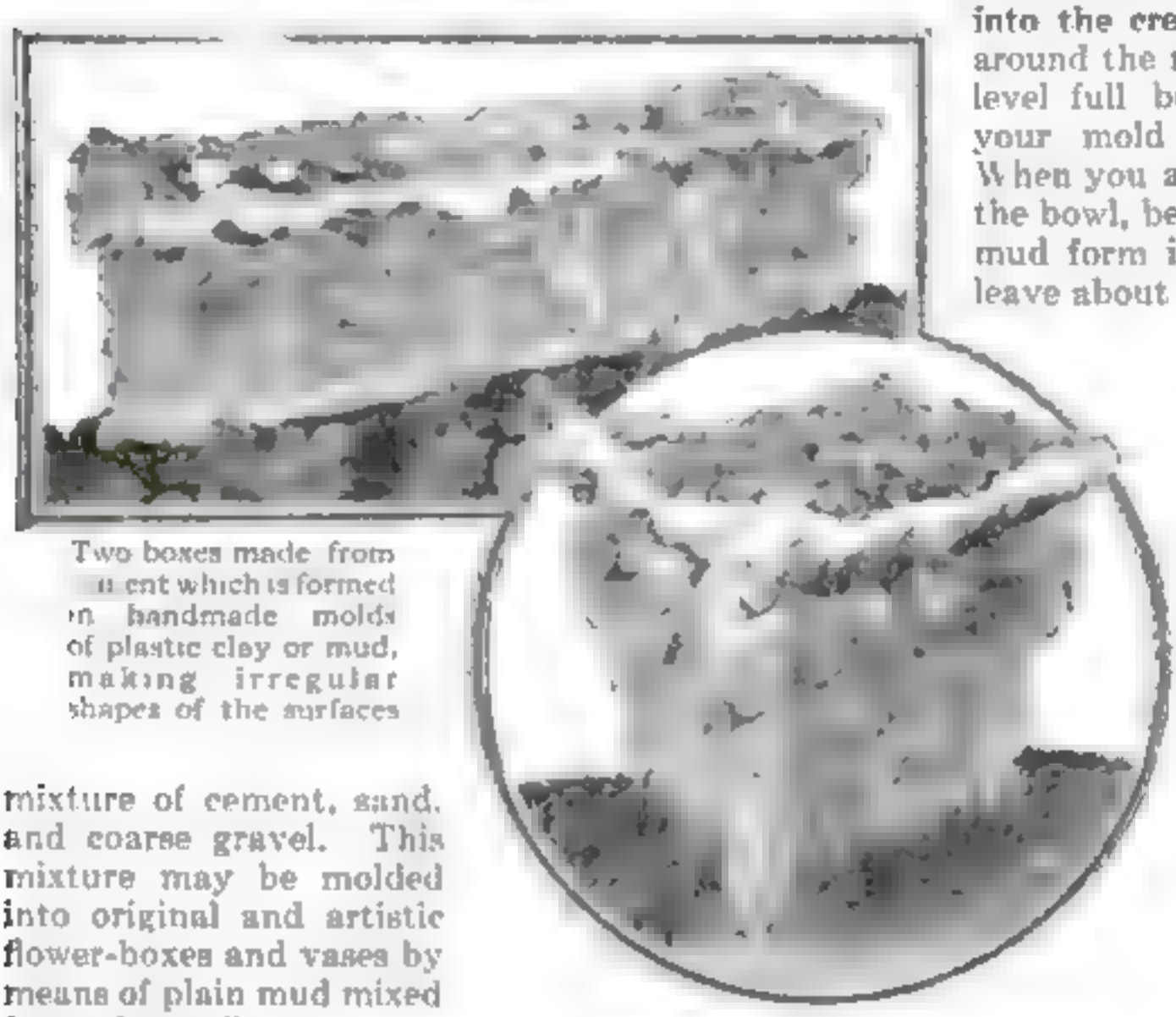


Various methods using different numbers of sticks of dynamite for felling trees

with a chain of cartridges placed on the same plane as in Fig. 5. The ring must fit snugly against the wood and should be fired with primers on both sides. This method is also effective for piles and trestles under water. The cartridges may be secured to a ring or hoop as shown in Fig. 6 and slipped down into place.—GEORGE M. PETERSEN.

Cement Flower Boxes Made in Mud Molds

MOST of the really artistic and beautiful flower vases and boxes of pottery and stone for use on verandas and lawns are very expensive. But the boxes illustrated may be easily made from a mixture of cement, sand, and coarse gravel. This mixture may be molded into original and artistic flower-boxes and vases by means of plain mud mixed from clay soil.



Two boxes made from cement which is formed on handmade molds of plastic clay or mud, making irregular shapes of the surfaces

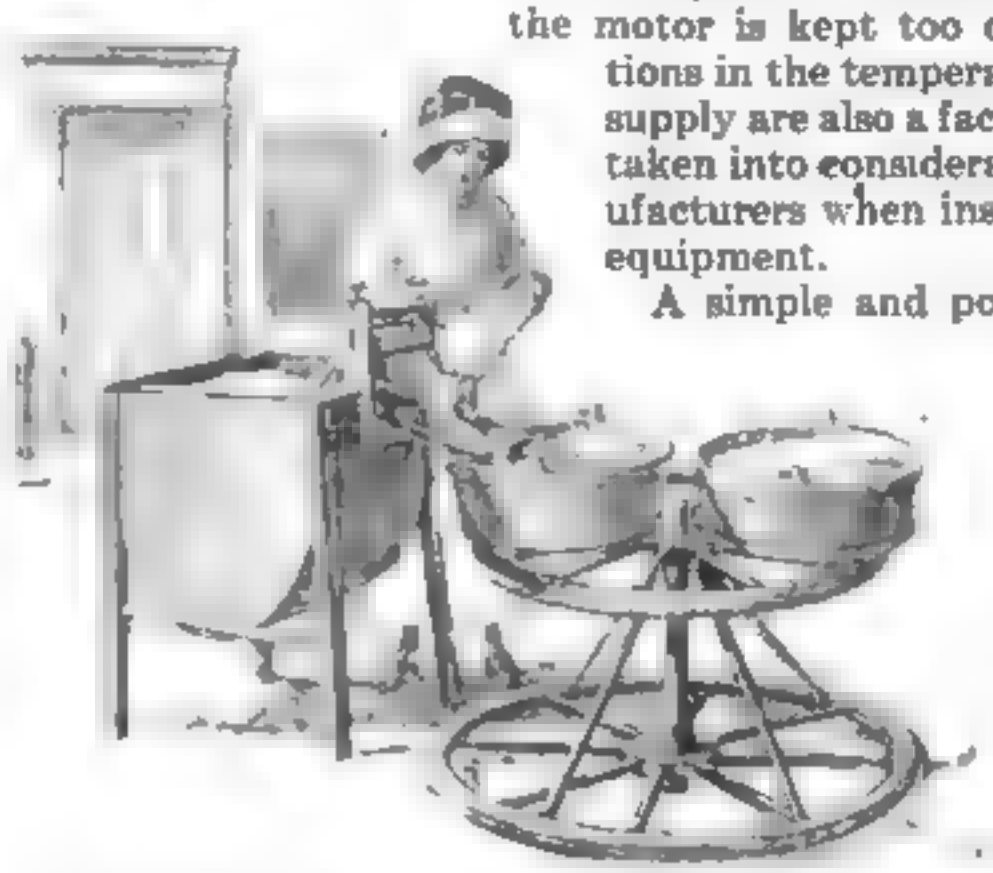
The beauty of the finished products rivals that of the most expensive flower vases and boxes of stone and pottery, and their cost is almost nothing. They can be made in any color or in blends of several colors by adding coloring pigments to the cement in the mixing.

To make them, follow these directions: Make a cement mixture of 1 part good cement; 2 parts washed sand, and 1 part washed coarse gravel. To this dry mixture add just enough water to make it run freely into crevices. Procure some clay soil that will mix up into a sticky mud and mix up a tubful of this to the consistency of putty. With bare hands take chunks of the sticky mud and slap it down on the ground in the shape you have decided to have the vase or box.

Remember that the inside of the mold you are forming should be kept rough and irregular. If you have your mud mixed to the right consistency you will have no trouble in taking it from the pile in large sticky lumps which you are adding to the base of the vase or box and piling it up, leaving the inside shape in the form of the receptacle you are making. Build up the mold about 18 in. high and then fill in with the cement mixture. It will run into the crevices everywhere around the mud form. When level full begin building up your mold of mud again. When you are ready to form the bowl, begin to build up a mud form in the center and leave about a 2-in. space all around the side walls of the mold. After it is shaped and built up high enough to suit your fancy, fill in with more cement mixture until it is level full. You now have the walls of the receptacle formed. Top them off with more mud, pressing the chunks down into the cement to give the edges of the walls thus formed an irregular shape in keeping with the rest of the receptacle. Let the whole mass stand undisturbed for one week, after which time the mud will begin to crack and break away. You can then chip it away carefully from the cement, revealing the shape of your flower vase or box. Dig the mud out of the bowl and let the cement weather for two days more. Now you can wash the mud out of the crevices in the cement, and you will be surprised at the artistic cave-rock formation you have obtained. After a little practice you will be able to create any formations you desire by shaping the sticky lumps of mud in that way. No two receptacles will ever be exactly alike. Once the cement is thoroughly dry it is as hard as solid rock. The boxes are as substantial as if made from solid stone and are practically indestructible.—J. R. SCHMIDT.

A Revolving Washtub Stand Made of Cart Wheels

AS the lady of the house asked for a washtub stand, the scrap pile was given a thorough search to find boards enough to make one. While doing this two discarded cart wheels were discovered and immediately these suggested the idea of building a rotating stand. The axle was procured and cut down so that its length was right to make the stand hold the tubs beneath the wringer on the machine. One wheel formed the base, to which braces were attached to hold the axle upright. The other wheel made the revolving top. Two or three tubs can be set on such a stand and be brought beneath the wringer in turn.—HENRY KLAUS.



The revolving upper wheel brings the tubs in their turn under the wringer upon the washing machine

Proper Cooling for Engines of Motor Boats

A CONSIDERABLE improvement can be made by motor-boat owners in the proper cooling of the engines as installed by the makers, that will result in increased enjoyment and comfort in the use of their craft.

As the water for cooling the motor is taken from outside the hull there is always a plentiful and cool supply to draw from, and the boat owner never has to worry about a leaky radiator or an overheated engine as does the autoist. But herein lies one trouble with many marine motors—they are often cooled too much. To obtain the greatest efficiency from the fuel consumed, a gasoline motor should run fairly hot. The fuel vaporizes more perfectly, the compression is better and therefore a motor develops more power when hot than when it is cold. Of course this may be overdone. There are certain limits that should be observed in both directions.

On many motor-boats the pipes for conveying the water to and from the engine, and also the water pumps, are much larger than needed and as a result the motor is kept too cool. The variations in the temperature of the water supply are also a factor that is seldom taken into consideration by the manufacturers when installing the motor equipment.

A simple and positive method of regulating engine temperature is to place an ordinary globe valve at some accessible point in the pipe line leading to the engine. By using this valve the heat of the motor can be controlled to compensate for the differences in the temperature of the water supply to secure the best working condition.

The proper cooling of the exhaust pipe line is another detail that is often not given proper attention by boat makers. When the exhaust pipe runs directly from the motor out through the side of the boat no cooling is necessary, but when it runs under the seats along the side and out at the stern the heat is unpleasant and may sometimes be dangerous.

To correct this trouble it is only necessary to tap the cooling water discharge pipe at some convenient point and connect a ½-in. pipe to the exhaust line. A globe valve should be placed in the pipe line to regulate the flow of water into the exhaust line. The connection into the exhaust should not be made too close to the motor; 8 or 10 in. from the cylinder is about right.

By adjusting the valve in the pipe line enough water can be admitted into the exhaust pipe to keep it cool.—N. C. HELMS.

Dissecting a Rubber Plant to Make It Grow

TO transplant rubber plants successfully requires careful work on the part of the inexperienced horticulturist. The rubber leaf should be cut off with a part of the plant attached to the leaf stem, as the accompanying illustrations show. The branch is so important that without it the leaf will soon wither and die. The next operation is to fold up the leaf carefully and to wrap it securely with a piece of string. The plant can now be planted in wet sand in a hothouse or placed under a bell jar in the home. The leaf is folded and tied so that the sun will not absorb the moisture from its delicate structure. This moisture, in turn, feeds the stem and branch of the plant until they are able to draw their own moisture from the soil.

Carefully handling the rubber plant for transplanting. The folding prevents evaporation

Cold Rolled Steel and Cold Drawn Steel

ALMOST every person in the mechanical trades is familiar with steel that is smooth and has a bright finish. This steel comes in bars, rolls and shafts, and most of us call it "cold rolled steel" or "cold drawn steel." As a matter of fact there is a wide difference between the two, in the process of making, in the nature of the steel, and in its use. To be strictly correct and to avoid mistakes, which may be costly, these differences should be carefully noted.

Cold *rolled* steel is, as its nature implies, rolled cold under great pressure, the material used for the purpose being hot rolled (black) stock. The machine which does this work is called a rolling mill, and consists of a pair of heavy, hard, and highly polished steel rolls mounted in a massive frame and suitably driven. The sheet or strip is passed between the rolls, which impart the smooth finish and exact size and shape, whether rectangular, square, round or otherwise. Due to the great pressure, the action of the rolling is also one of squeezing, and the stock comes out thinner, wider and longer than when it went into the rolls, and with a rounded edge, which retains the black finish of the original.

Cold rolled steel may be obtained in "flats" and in strips in a great variety of sizes and in thicknesses of from .002 in. up. It is relatively soft and is used mostly for bending and stamping purposes where a steel of accurate thickness, bright finish, and easy working qualities is desired. The thinner and narrower stock may be obtained in coils or rolls for use on automatic machines that work from a continuous piece. Cold rolled steel is used extensively for drawing operations; that is, for the making of caps, cups, covers and shells.

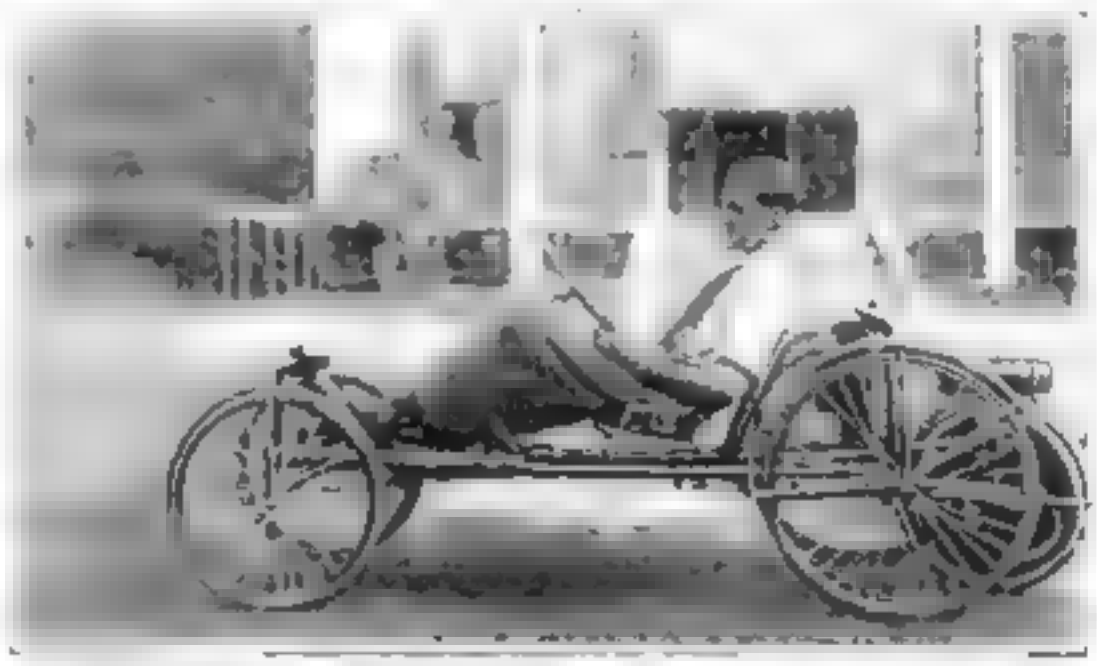
Cold *drawn* steel is finished by an entirely different process. It is this process that gives us shafting, bars, rods and keys, smooth, bright, strong and very accurate. To obtain these desirable qualities a bar of hot rolled steel, slightly larger than the finished size, is run through a machine known as a draw bench, which has a highly polished, heavy and hardened steel die with an opening the exact size of the finished bar. By means of a powerful chain and gripping apparatus, the bar is pulled or drawn through the die.

Buckboard Driven by Motor Wheel

Detailed description of how to make a buckboard to be propelled by a push-motor wheel

By Frank W. Vroom

NATURALLY, the first part of the work upon this buckboard is the frame. The material to use is perfectly dry, straight-grained ash. If this wood is not obtainable, well-seasoned hickory $\frac{5}{8}$ in. thick may be used. It will require five pieces of ash, each 5½ ft. long, 2 in. wide and $\frac{7}{8}$ in. thick. These are joined together at the ends with cross pieces, the front cross cross piece should be 18 in. long and the rear one 24 in. long, both should be 3 in. wide and $\frac{7}{8}$ in. thick. These are fastened to the underside of the long pieces with wood screws, or, better still, with some small bolts. Another cross piece 21$\frac{3}{8}$ in. long and 2 in. wide is placed across the frame pieces at the point where its length corresponds to the width. This piece is to hold the ends of the strap iron braces which support the outer ends of the rear axles.

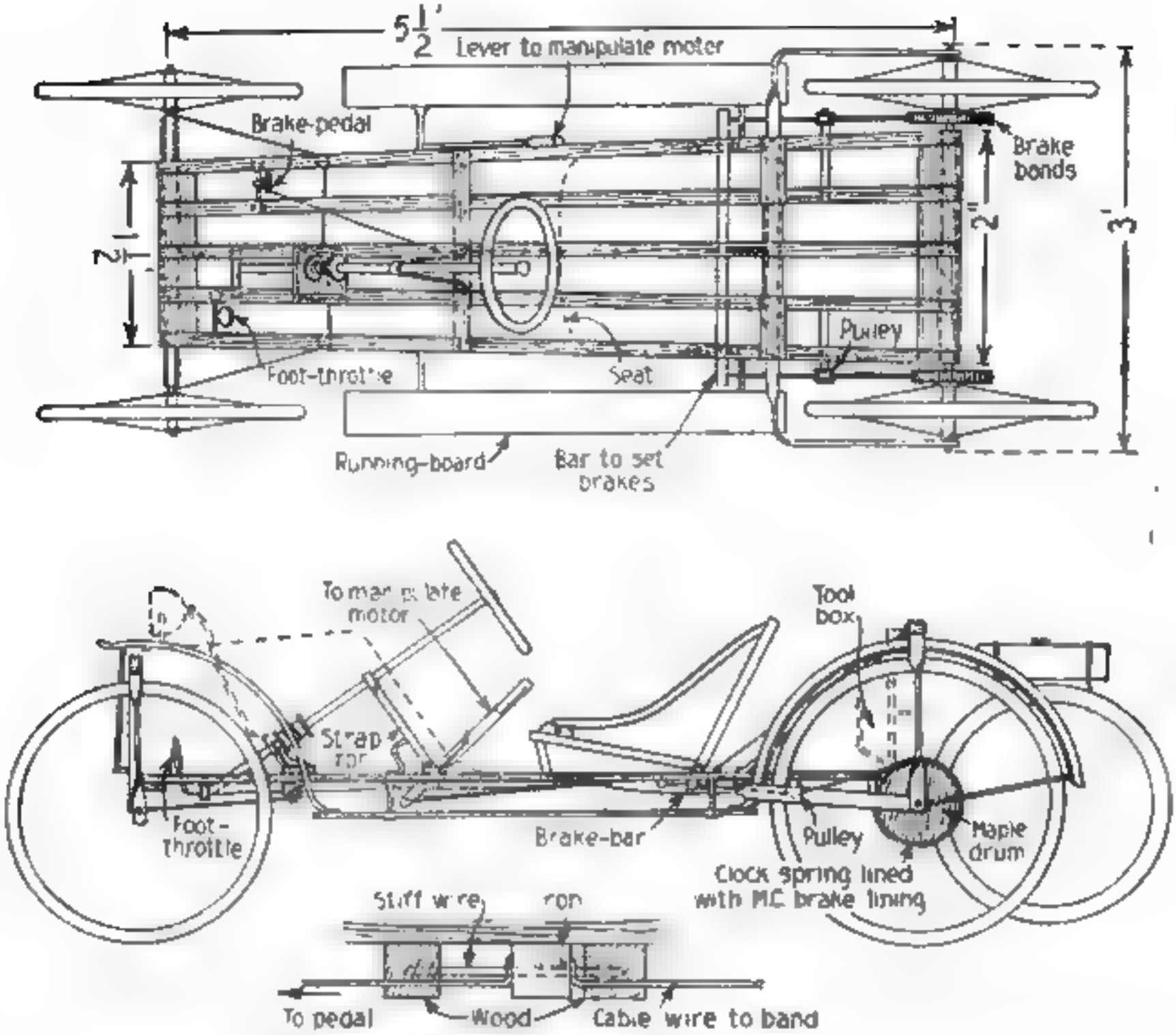


The finished buckboard presents a very neat appearance and will carry its load as fast as a motor wheel runs

The axles are made of 1-in. square bar machine steel, each 3 ft. long with the ends turned down to $\frac{3}{8}$ in. in diameter for a length of 5½ in. These are threaded to take a bicycle wheel cone snugly. Holes are drilled 6 in. in from the shoulder for a small bolt to fasten the frame to the axle. The rear axle is placed directly beneath the cross piece and the front one is fastened to a piece of oak 2 ft. long and 1¾ in. wide. Bore a hole in the center of this oak piece to receive a bolt $\frac{5}{8}$ in. in diameter. This bolt is 4½ in. long. As regular bicycle wheels are used, the axle ends are threaded to receive the cones front and rear and nuts on the ends to hold the adjustment. The front wheels are 24 in. and the rear ones 28 in. in diameter. Non-skid tires should be put on the rear wheels.

The easiest way to equip the machine with mudguards is to utilize the regular stock guards used for bicycles. Second-hand guards can be purchased at a reasonable price and they will do as well as new stock.

The steering post consists of a piece of gas pipe 2½ ft. long and $\frac{3}{4}$ in. in diameter. A block of oak, or other hardwood, long enough to reach between the center slat and the next one to its left, has a slanting hole bored in it which brings the other end of the pipe at a position most convenient for the operator to handle the wheel. The angle is about 45 deg. The best way to find this angle is to incline the pipe with one end touching the block under the slats and to tip the other end until the distance, at the right angle, between it and the frame measures 19 in. This brings the steering end at a convenient position for the average person. The block should be well up in front. Another block should be set on top of the slats at a point where the pipe will intersect it. The pipe must be allowed to turn freely in a hole bored into its center. This block should be halved, or sawed through the center lengthwise and held together with an adjustment screw in each end. For additional support, a piece of strap-iron should be bent over a pipe the size of the post and the parts riveted together like a clamp.

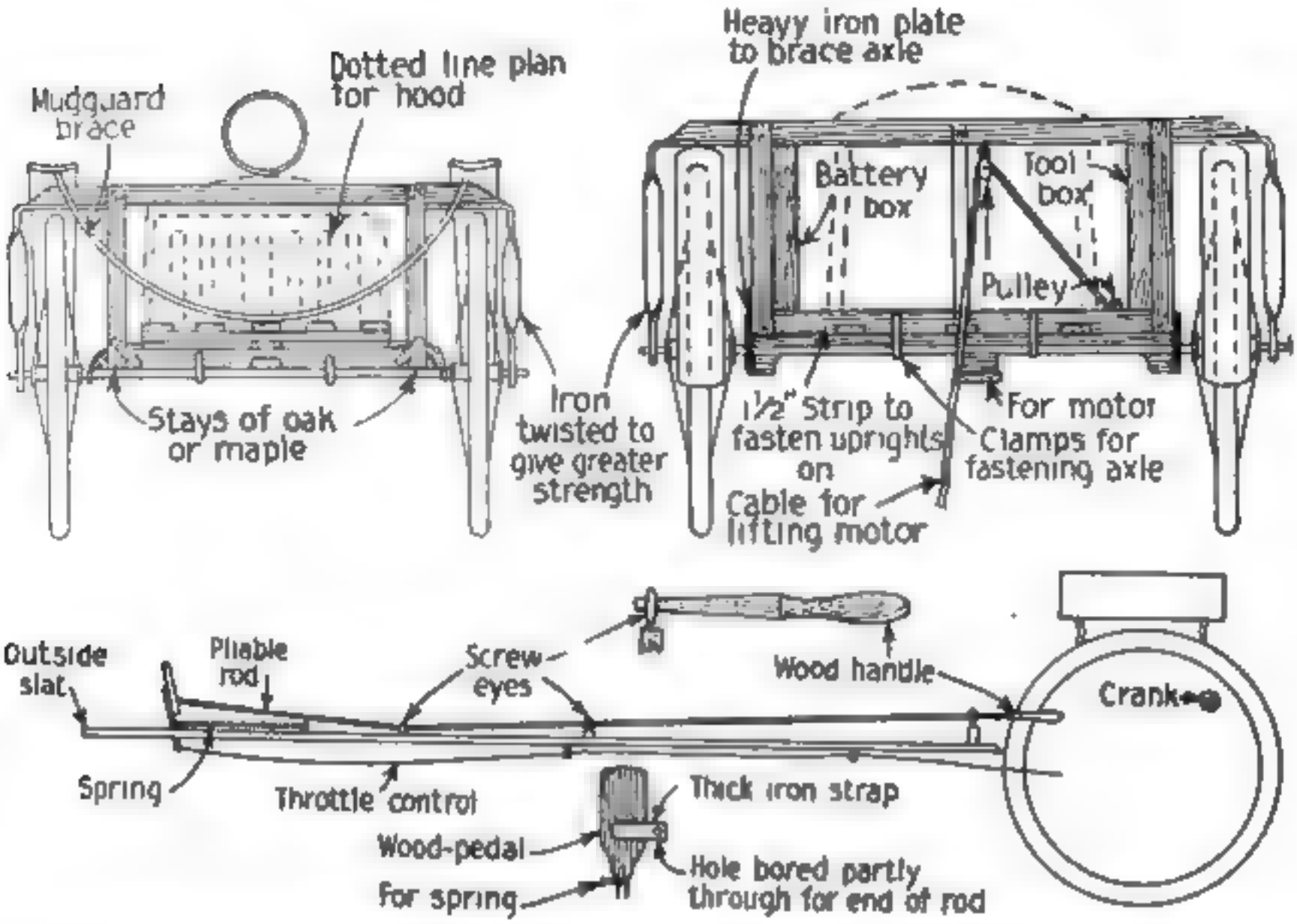


The connecting link between the front and rear axle is made up of five pieces of ash which furnishes the spring to ease the rider. Driving attachments are fastened to these pieces

Then fasten the ends to a cross-piece on the slats, spreading them out at the bottom like the shape of an inverted V. The steering wheel can be made, if desired, or it can be purchased. A wheel may be obtained such as is used in the place of handlebars on a bicycle. This is fastened to the end of the post.

The steering is accomplished by an arrangement of five pulleys of the drum-cable variety. Four 2-in. pulleys are placed under the frame; two on a ⅜-in. rod placed directly under the steering post, and at the same angle as the post over which the cable passes. The other two are placed, one on each side of the frame, outside of the slats. One of them should line with the pulley next to the post block and the other with its mate. The drum—large pulley—should be 3 in. long and 3 in. in diameter, and it should be placed close to the top of the block on top of the frame. It is fastened to the steering post with a long wood screw, which goes through a hole bored through the center of the pulley, and a similar hole drilled through the post. The hole in the post should be a sliding fit for the screw and the hole in the pulley should be a tight fit. Fasten a 6-ft. length of wire to one side of the front axle. Pass it around the pulley under the frame to a pulley on the shaft under the post and then to the drum on the post. Wind four turns around the drum, and run the end down under the other pulley on the shaft. Then pass it around the outside pulley and fasten to the other end of the axle.

The lamp was made from a large oil can. The spout was removed and the hole reamed out to receive the screw end of a 12-candle-power electric globe. The

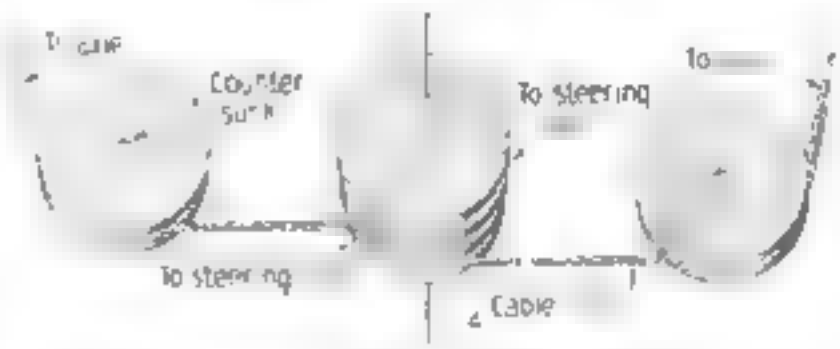


The upper picture shows the front and rear part including the axles and wheels and the lower one the arrange nent of the foot pedal and rear control of the throttle with a wire and rod

bottom of the can was removed, care being taken to leave a clean edge. A round piece of glass was cut out and its edge covered with a strip of sheet galvanized metal which was cut as shown. This covering was hinged to the side of the oil can and a snap fastener was attached.

The brake drums were made of hardwood, cut and turned to a diameter of 6 in. The centers were bored out to fit over the check nut on the wheel hub The drums were fastened to the sprocket by drilling four holes through the latter into which were inserted screws or small bolts. A strip of metal was fastened to the outside surface for the brake strap to rub against. Measure three-quarters of the distance around the disk and cut a heavy clock spring to this length. Draw the temper in each end and drill two small holes in one end and rivet it to a piece of ½-in. square bar 3 in. long. Drill a single hole in the other end and fasten a cable wire for operating the brake. Bend the spring to the curve of the disk and rivet a strip of motorcycle brake lining to inside surface. If this material cannot be procured, a heavy piece of leather will do, but it will not wear so long. Fasten the free end of the bar to the under side of the outside slat at a point where it will just clear the disk. Fasten a piece of 3/16-in. cable wire to the single hole and run it down and under a wood pulley placed midway between the disk and brake bar, as shown, thence to the end of the brake bar where it is fastened in a notch.

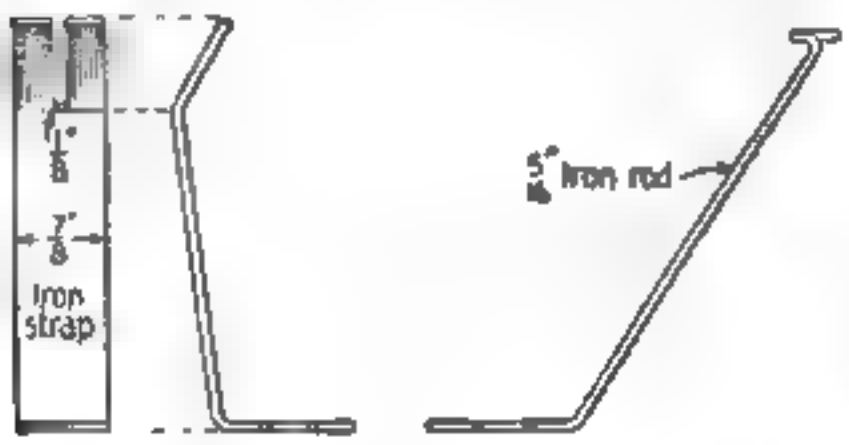
The brake bar is made of a piece of ½-in. square bar steel, placed across the

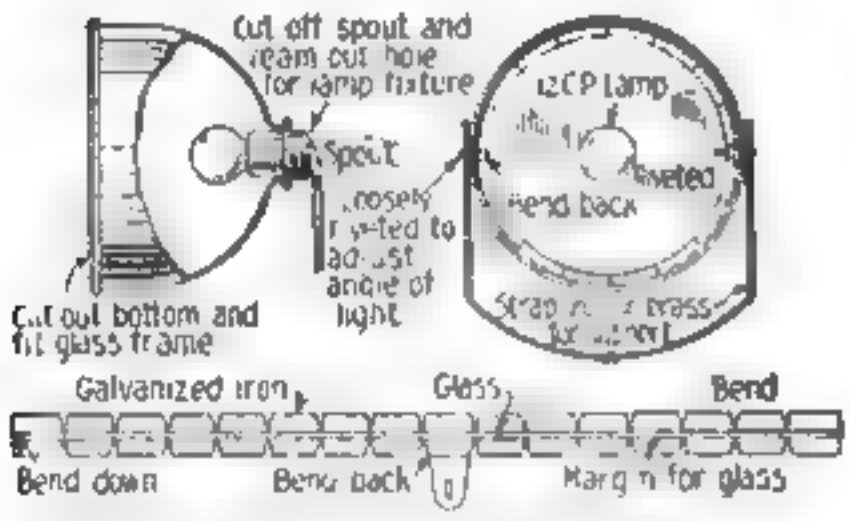


The arrangement of the pulleys, wire and drum for the steering of the front wheels

slats toward the front as shown. It is fastened by boring a small hole through the center and at each end. A small,

stiff wire should be run through a small block previously bored for a close fit in the hole in the end of the bar and through a hole in a similar block placed 3 in. from the first block. The opposite side is made in the same manner. Fasten a





The braces for the frame and the construction of a lamp by using an oil can

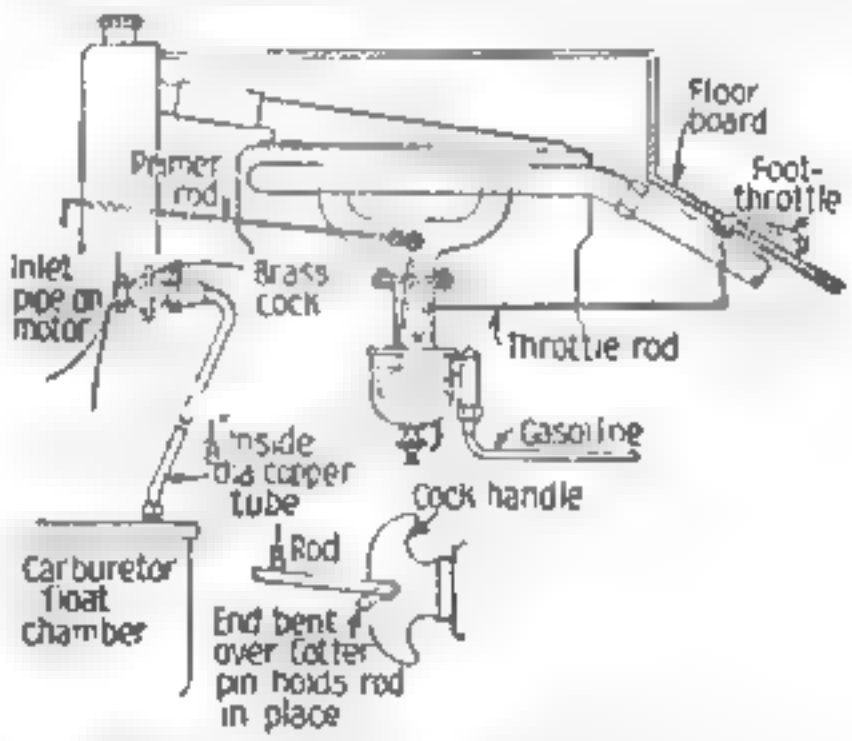
short length of stiff spiral spring to the center hole in the bar and fasten the other end to a cross bar of wood as shown. Run a length of cable wire from the center of the bar to the foot pedal in front. Run this cable straight on the center slat for half the distance to the pedal and then turn it off to the pedal and fasten it.

All braces are made of 1/8 by 7/8-in. strap iron. The braces, from the frame to the axle, are twisted in the center to make them more rigid. After placing the uprights, these braces can be easily measured and fitted in place. The end stays should be bent at right angles at the proper height and then they should run to the upright as shown. The side braces from the frame to the axle are run all the way across the frame, joining in the center of the wood cross piece. Turn three or more screws in each piece, securely fastening them in place, as these uprights form the main support for the axle ends. The seat was made of an old chair cut down to a convenient size.

The motor wheel is provided with fastenings for attaching it to the rear cross-piece of the frame. Provision may be made for lifting the wheel from the ground by means of a foot pedal for stopping and starting the buckboard while the motor is still running. This provides a way to start the engine without running the machine along the road.

Priming an Automobile Engine to Start It Easily

IN winter weather a primer for the automobile motor is very essential and the idea here illustrated combines practicability with simplicity at small cost and is convenient as the hood over the engine does not need to be raised. It is made as follows: Drill a 1/4-in. hole in the intake manifold pipe and fit a brass cock in it, care being taken in drilling and tapping the threads so that the aluminum is not ruptured. Drill a 3/16-in. hole in the top of the carburetor float chamber and connect it as shown. The bottom end of the primer tube must be so placed in the carburetor float chamber that it does not interfere with the float, but the end of it must enter under the gasoline level. To prime the motor, simply open the valve on the intake manifold and the motor will draw in raw gas, automatically priming itself and greatly facilitating the starting



Hand controlled connection for admitting a rich mixture to manifold from carburetor

of the motor in cold weather. If the motor is a self starter, run the primer rod to the dashboard and reverse the position of the cock.—P. P. AVERY.

Affixing a New Bearing Surface to an Engine Crankshaft

WHEN a bearing becomes slightly worn it not only wears faster, but it may do a great deal of damage to the other wearing parts of the machine in which it is located. There is no part of an automobile that can cause damage quicker than the crankshaft of the engine, and one loose bearing will soon cause wear on all the working parts. If the engine produces a "knock," remove the radiator and run the engine a few minutes.

This will usually give evidence of the worn part. Most engines have the front bearing solid, at least it was so in the engine to which this deacription relates. In this case the crankshaft was considerably worn and it was necessary to cut it down somewhat to obtain a new straight bearing. This was done as shown in the illustration. The space was filled in with a two-piece bearing, scraped to fit the shaft. It was drilled for oil holes and grooves were cut in it like the other bearings. To assemble it, set the crankshaft in the case and apply the two parts, then force it into the front bearing. Drill holes through the bearing and parts, and tap for setscrews to hold them in place. This will make such a bearing as good as new.—P. P. AVERY.

Small Wood-Working Clamps Made of Skate Parts

THERE are lots of little jobs in the shop where clamps are needed—gluing up small pieces of wood, for instance—and the ordinary clamps are too large. For such work, the clamps from old roller or ice skates can be used. Take the two clamps and the screw and use the skate key to tighten them on the work. Put a small piece of wood under each to prevent the work being bruised or dented. This is a cheap and accessible expedient as old skates are to be found in most households. KINGSLEY GREENE.

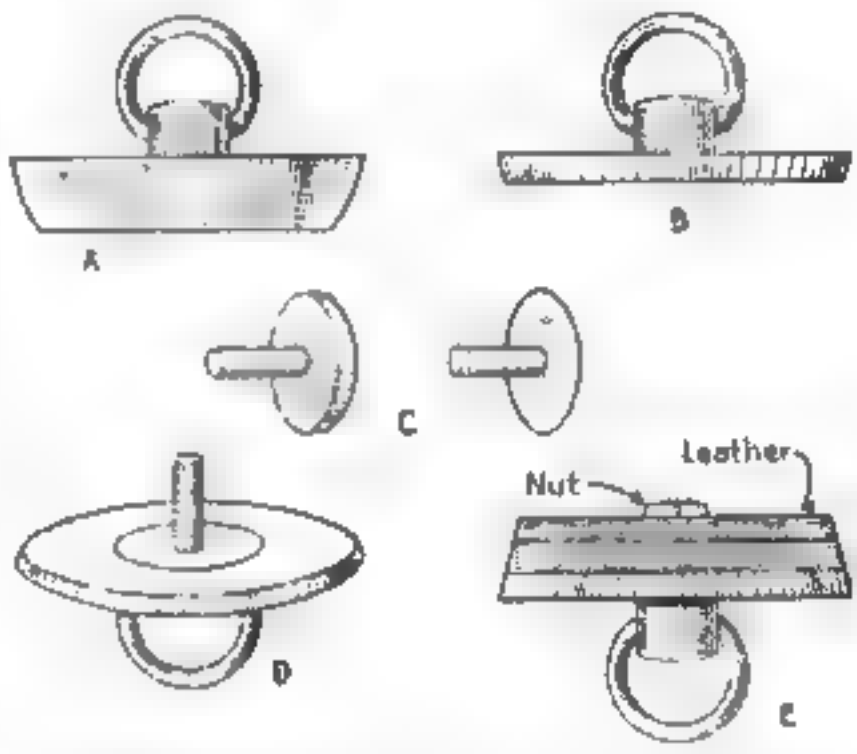
Shaping a Bottle Cork to Make a Medicine Dropper

Notches as they are cut in the cork

AVERY convenient form of medicine dropper may be made by any one upon a moment's notice by simply cutting two small notches in the sides of a cork, as shown in the illustration. When inserted in the neck of a bottle the liquid may be poured out in a regular intermittent flow of drops as slowly or as rapidly as desired. The neck of the bottle should be held just a little above the horizontal to prevent a too rapid flow, particularly in the case of poisons.—FLOYD L. DARROW.

How to Repair a Worn Wash Bowl Plug

A BRASS bowl plug had been in constant use for a long time and the wear rounded the edges on the underside as shown at *A*, the edge being a mere shell from the wear. The worn part was filed down as shown at *B*, next a screw

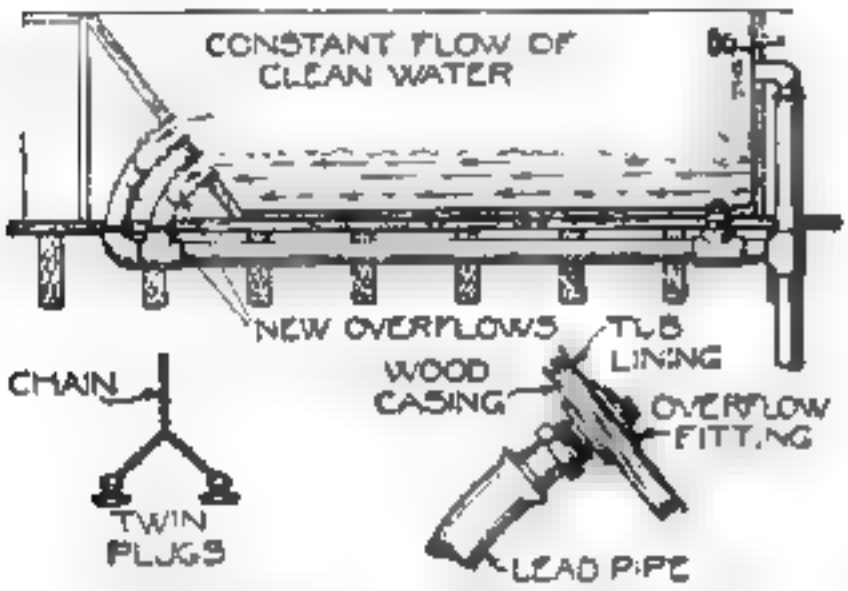


Making a new contact surface of leather on the face of a worn wash bowl plug

terminal, *C*, taken from the end of a battery-carbon was soldered on as shown at *D*. With this attachment, two leather disks were secured to the surface with a nut. Then the edges of the leather were trimmed down to the original form of the plug as shown at *E*.—JAMES M. KANE.

Systematic Control of Water in a Bath Tub

A RESIDENT of a small city, wishing to eliminate the final sponging with clear water, necessary to remove the previously applied coating of soapy liquid, decided upon this method of keeping the water constantly clean. As the tendency of the water was to carry the soapy matter to the end farthest away from the bath overflow, two overflows and plugs were fitted at the opposite end, thereby providing for two water levels. Regulating the flow of water from the bibbs, the bather was able to keep the unclean water constantly moving out of either of the two overflows.—JAMES M. KANE.



Two overflows at different levels in the bath-tub, opposite to the faucet

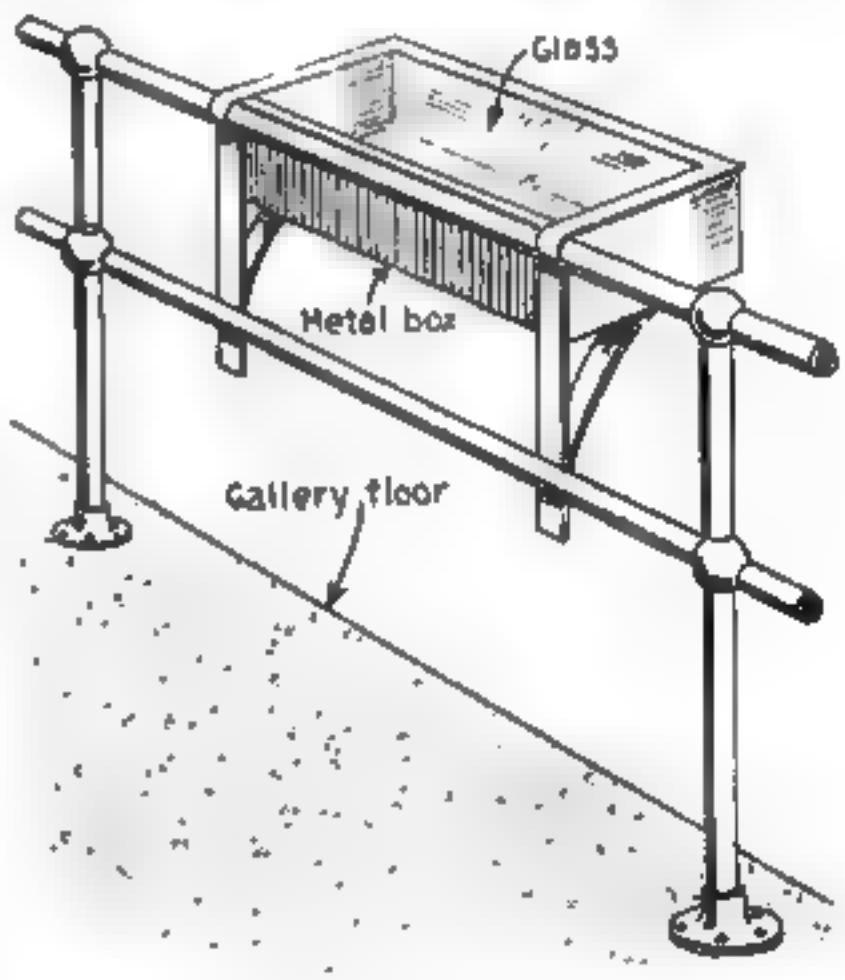
A Cement for Firmly Holding Glass on Metal

ONE of the best cements for joining glass to other substances consists of a mixture of gum arabic and calomel. Its adhesive power is great. It is prepared by putting the very best and purest gum arabic into a small quantity of water, and allowing it to stand overnight so that it attains a glue-like consistency. Calomel, or as it is sometimes called, mercurous Chloride or subchloride of mercury, is added in a sufficient quantity to make the mass a trifle more sticky. The ingredients are thoroughly mixed on a glass plate with a spatula. Calomel is a poison, so no more should be made than is required for immediate use. This cement hardens in a few hours, but the most satisfactory results are obtained when it is permitted to stand for one or two days. To insure a very serviceable cement it is necessary to utilize only the best materials, as inferior grades are useless. Another excellent glass cement is made from gum mastic, powdered isinglass and alcohol.

Fastening Cases to Railing in Historical Museum

THE method used in placing the manuscript cases in the Historical Society building in a small city is shown in the illustration. It is a good example of economy in space. The gallery running around the upper section of the library room has a pipe railing to keep the clerk from falling off to the lower floor.

The upper rail has been utilized to hang cases containing valuable manuscripts. The framework of the case is of flat iron, the back ends of the top being curved so as to hook over the upper pipe rail.



A glass case holding manuscript for exhibition on the guard rail of a gallery

By using this method the manuscripts are perfectly safe, they are in a good light, and it is possible to examine each one by itself.—JAMES M. KANE.

Simple Designs for Sheet Metal Working

XI.—Radial Line Method of Developing Patterns for a Ventilator and a Scale Scoop

By Arthur F. Payne

Former Director of Vocational Education, Columbia University

FOR those who have developed the problems explained in the last issue, Fig. 1, "pattern for ventilator on roof with one-third pitch" will merely be an easy review of the principles involved.

Before starting on the pattern development it is necessary to explain the meaning of the term "one-third pitch" as applied to a roof. When an order comes into the shop for a ventilator of any given size which is to be placed on the side of a roof, it is necessary to know the pitch and angle of the roof. The contractors always state that it is a one-third, one-fourth or one-sixth pitch. Before this can be explained it is also necessary to become acquainted with the terms "span," "run," "rise," and "pitch."

As shown in Fig. 1, the "span" is the entire width of the roof; in this case it is 24 in. The "rise" is the length of a line dropped straight down from the ridge until it is level with the edges of the roof, in this case the measurement is 8 in. The "pitch" is the relation between the span and the rise. In the illustration the rise is 8 in., the span is 24 in., 8 in. is one-third of 24 in., therefore the pitch of this roof is one-third. If the rise had been 6 in and the span 24 in., the pitch would be one-fourth because the relation of 6 in. to 24 in. is 4 ins. Conversely, if the rise had been 4 in. the pitch would be one-sixth because 4 in. is one-sixth of 24. It is essential to know the pitch of the roof before we can develop the ventilator pattern.

The pattern for *A* only has been developed because *B* is a simple cone, the development of which was given in the March issue. As the ventilator is a round one, it can readily be seen that *A* is part of a cone. First, it is necessary to draw the full view of the ventilator as shown. Second, draw the full cone as indicated, with *C* for the apex and 1-9 for the base line. Third, draw the one-half bottom view as shown by *D*, and divide this into eight equal spaces. Fourth, run these points straight up to the base line, then to the apex *C*. Fifth, where these lines cross the roof line run them over to the line *C*-9. Sixth, with the length C-9, as radius strike the arc *E-F*, and get the correct length by stepping off one of the spaces on the bottom view sixteen times. It must be understood that the bottom view has only eight spaces because it is only one-half of the bottom view, but there must be sixteen spaces in the pattern because it is the full pattern. Seventh, from the line *C*-9, swing the true lengths (explained in the last issue) over until they intersect the same numbered line coming up from the

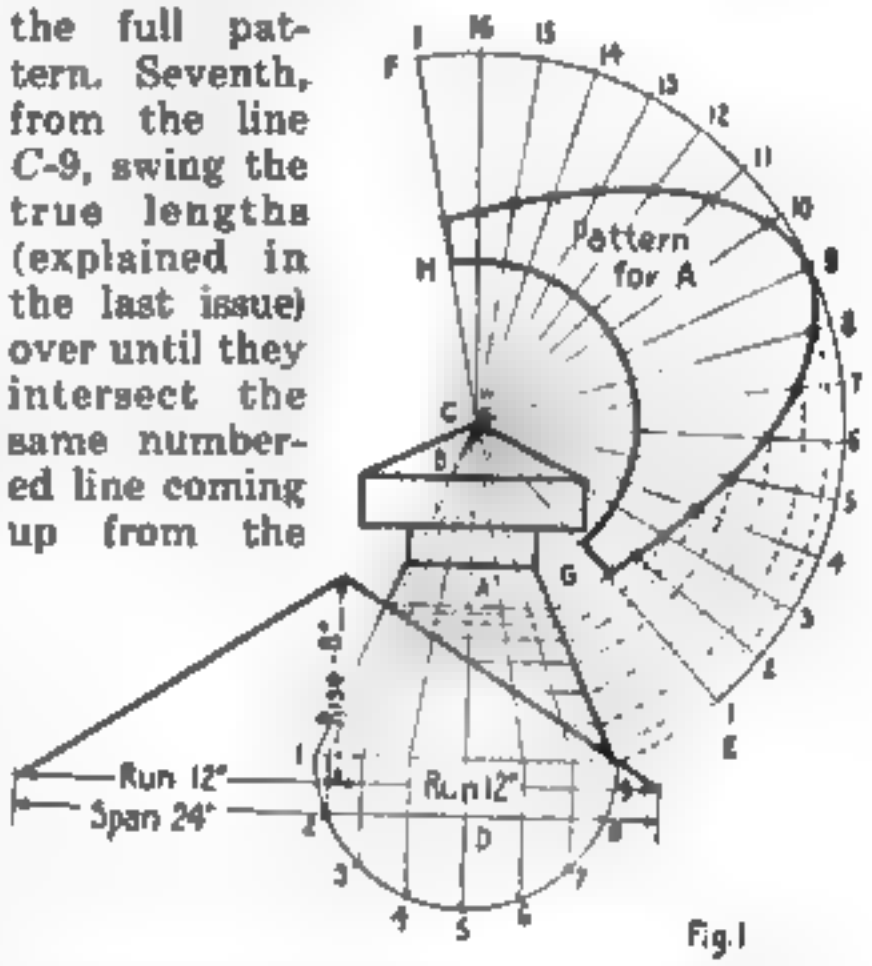


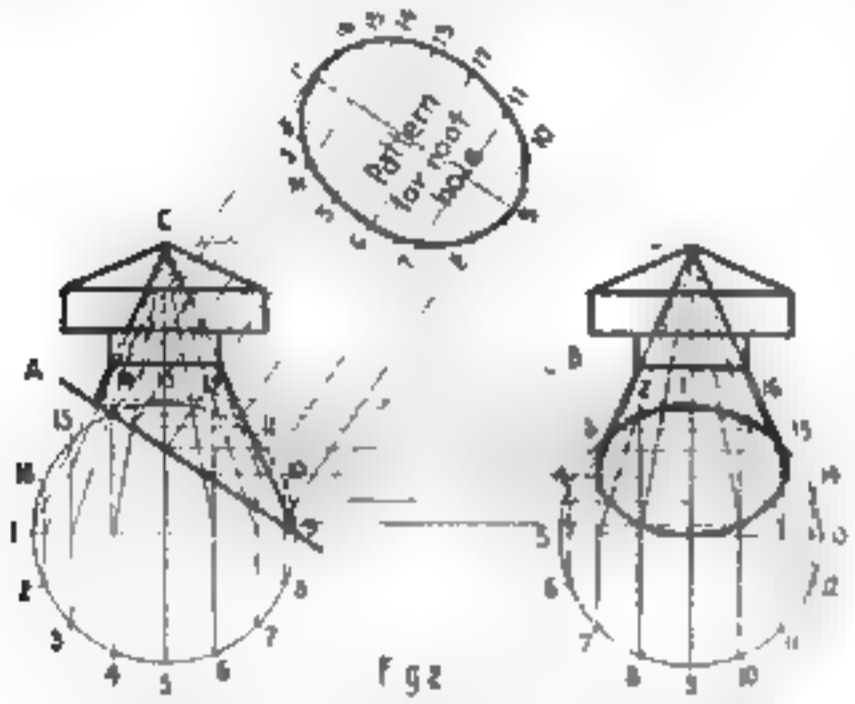
Fig. 1

A pattern layout for making a base to a ventilator to be placed on a sloping roof

arc *E-F*. At the intersection make a cross, connect these crosses with a free curve and we have the bottom line of the pattern. Eighth, to get the top line of the pattern set the compasses at *C* and *G*, then swing the arc *G-H*, which gives the top line, thus completing the full pattern for *A*. The patterns for the straight collars can be quickly developed by methods explained in earlier articles.

No attempt has been made in the drawing to show the full construction of this

ventilator, or to give sizes, as it would complicate the drawing and confuse the student. Allowance must be made on the patterns for all seams and wiring.



Laying out a pattern for cutting a hole in the roof for insertion of the ventilator base

A very interesting and simple problem that is not generally known among sheet metal workers is shown in Fig. 2. If, when making the ventilator shown in Fig. 1, it is desired to obtain the pattern for the hole in the roof, the method is as follows: First, draw view *A* with the full bottom view as shown by the circle. Second, divide the circle into sixteen parts, and project the points to the base line. From where they cross the base line, run the lines up to the apex *C* exactly as was done in the preceding problems. Third, from the points where these radial lines intersect the roof line, draw lines at exact right angles, as shown in the drawing. Number these lines, giving them the numbers at the bottom view points from which they started. Anywhere on these lines, draw the center line 1-9 parallel to the roof line. Notice that now we have the exact length of the hole and the exact location of each radial line. If we can now get the exact width on each of these lines, we shall have our pattern. We can get these widths by drawing a front view. Make the drawing the same as for the side view except that the roof line is omitted. Notice particularly that the numbers on the bottom view circle have been turned one-quarter circle to the right, although on the ventilator they are, of course, in the same place. For instance, 1 is the highest point and 9 is the lowest point on both views. Fourth from view *A*, where the radial lines cross the roof line, run lines to the front view *B*. Make a cross where these lines intersect, the same numbered lines coming up from the bottom view circle. Connect these crosses with a curve and you will have a true front view of the joint between the ventilator and the roof. It is understood that the upper part of the oval would be back of the ventilator and therefore invisible from the front. Sixth, to transfer these widths to the pattern, place one point of the compasses on center line, and find the width of 2-16, then lay this off on the 2-16 line of the pattern. Transfer all the other widths in the same way, connect the crosses with a curve and you will have the exact pattern for the roof hole.

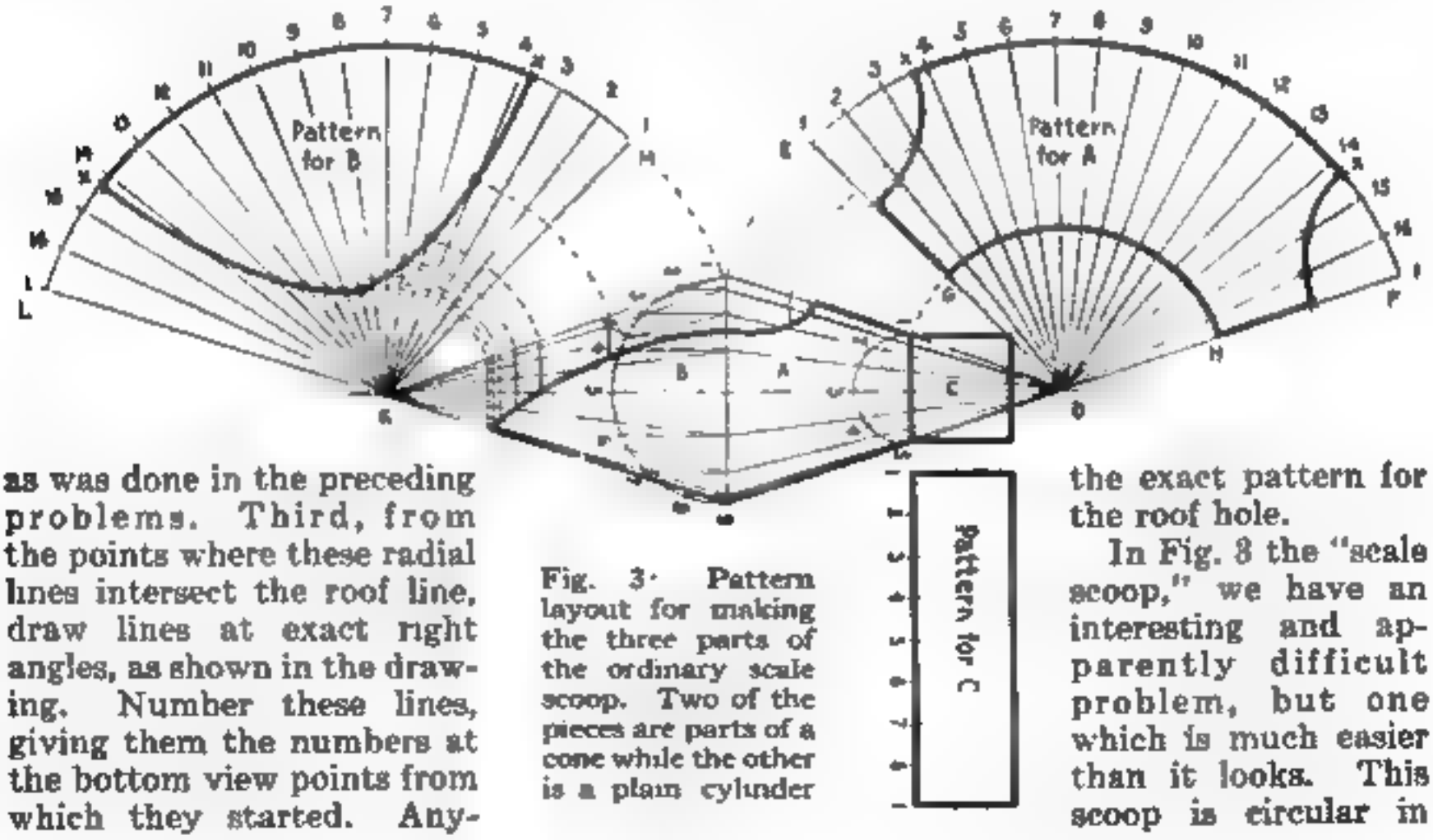


Fig. 3. Pattern layout for making the three parts of the ordinary scale scoop. Two of the pieces are parts of a cone while the other is a plain cylinder

In Fig. 3 the "scale scoop," we have an interesting and apparently difficult problem, but one which is much easier than it looks. This scoop is circular in

form and by examining the drawing it can be seen that *A* and *B* are part of cones of the same size. *C* is a plain cylinder, the development of which has been explained earlier in this series.

To develop the pattern for *A:* First, draw the complete cone with apex at *D* and base line at 1-9. Second, draw the one-half bottom view, divide it into eight equal parts, from these points project lines up to the base line and then to the apex, *D*. Third, with 1-*D* as a radius, strike the arc *E-F*, get the correct length by setting off sixteen spaces from the bottom view as previously explained and draw radial lines to apex *D*. Fourth, from where the curved part of the scoop crosses the radial lines going up from the base line to the apex, draw lines over to line 1-*D* to get the true lengths as explained in the last issue. Swing these lines over on to the pattern until they cross the same numbered lines coming up from the arc *E-F*. Sixth, it will be noticed that the curve of the scoop in *A* does not cross the base line at the same place as one of the radial lines, so we must use an "auxiliary" line such as we have used in a previous problem. This is used in the following manner: From the point where the scoop curve crosses the base line, draw a line to the bottom view and mark it *X* as shown in the drawing. It can be seen that it lies between 4 and 3. Measure the distance from 4 to *X* and lay it off on the pattern arc *E-F* as shown. This will indicate the corner of the pattern. Do the same for the opposite side of the pattern, and the pattern for *A* will be complete.

Exactly the same method is used in developing the pattern for *B*. The steps are briefly indicated as follows: First, draw full cone. Second, draw one-half bottom view and run lines to apex *K*. Third, strike arc *L-M* with *K*-1 as radius. Fourth, draw lines from points where scoop curve crosses radial lines to line *K*-1, to get true lengths. Fifth, swing these lines in arcs to pattern. Make crosses where they intersect same numbered lines. Sixth, make use of auxiliary line *X* in exactly the same way as for pattern *A*. Connect the crosses with a curve and the pattern is complete. Make allowance for seams and wiring as previously explained.

Cutting Asphalt After Removing Metal Covering

ASPHALT is usually shipped in tin barrels. The metal is stripped off and the asphalt rolled up to the stopping board; the wire shown, attached to the

Cutting asphalt taken from barrel with a wire drawn through it with a windlass

winding drum, is passed over and around the asphalt to a piece of pipe under and ahead of the stop board. When the drum is turned it tightens up on the wire and causes it to cut through the asphalt. Kerosene is poured on the wire to make it pass through the asphalt easily.

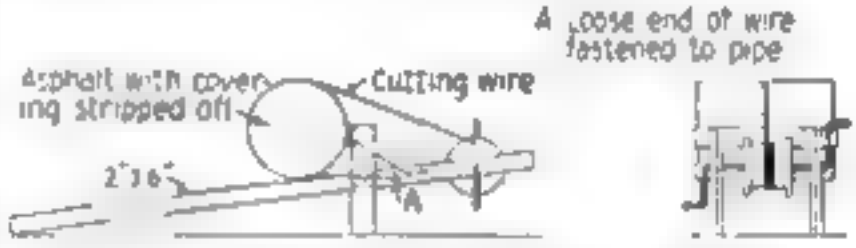


Diagram of the table, stop, and windlass for pulling the wire through the asphalt

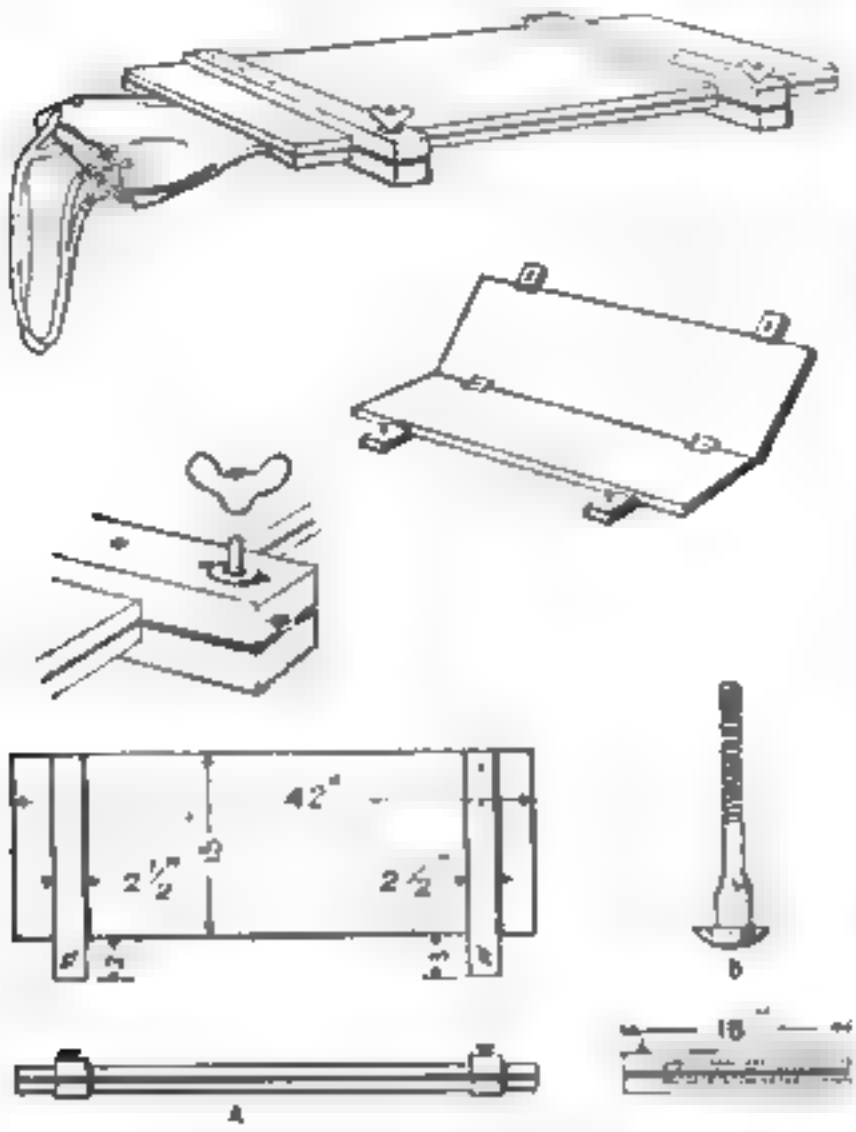
The barrel shape is first cut in half, then each half is cut into quarters which a man can handle easily. In warm weather asphalt is soft, therefore it cannot be cut or broken with an ax or other tool, so this machine is a time and labor saver.—GEORGE C. PECK.

Intensifying Under-Exposed Blue-Prints with Hydrogen Peroxide

AN under-exposed blue-print can be intensified by moistening its surface with a sponge dampened with peroxide of hydrogen. Old blue-print paper which would otherwise produce an indistinct copy need not be thrown away if treated with peroxide after the print has been exposed and "fixed."

Making a Simple Press of Boards for Trousers

WHY not let this simple board device press your trousers while you sleep? Two pine boards, cleated as at *A*, are hinged together, and the inside surface



Clamping your trousers between boards for creasing them by pressure overnight

covered with canvas. The latter is slightly dampened before the trousers are put in. The bolts, *B*, are tightened by means of wing nuts, which rest upon washers, as shown. Simply lay the article to be pressed flat and close the two sections of the press like a book. After the wing nuts are turned down tightly, the press may be hung up out of the way. Either clear white pine or cypress is suitable for making the press. Fasten with brass screws.—H. ADLON.

An Interesting Demonstration of Spontaneous Combustion

A VERY simple and effective demonstration of spontaneous combustion can be made as follows:

Dissolve a piece of yellow phosphorus, about the size of a pea, in a small bottle containing a tablespoonful of the liquid carbon disulphide. Pour the solution over a small, thin piece of porous paper. After waving the paper back and forth for about thirty seconds, it suddenly bursts into flame. The carbon disulphide quickly evaporates, leaving the phosphorus, in a finely divided state, spread over the surface of the paper. Since phosphorus oxidizes very rapidly and has a low kindling temperature, the heat of oxidation quickly brings it to this point with the result already described.

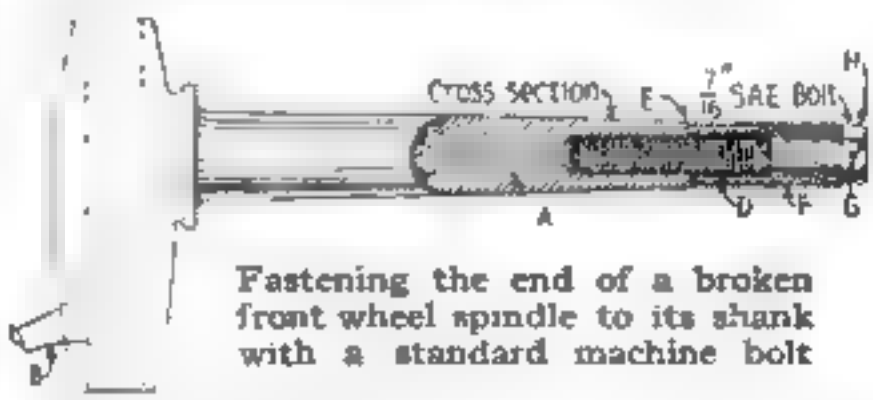
Phosphorus produces very severe burns and must be kept and cut under water. Do not handle it with the fingers—use forceps. Keep the carbon disulphide away from a free flame. If care is exercised, no danger attends this experiment. It is rather odoriferous, though.

Temporary Repair on a Broken Front Wheel Spindle

IF a front wheel spindle of an automobile, or any axle of a similar type, or a shaft or rod becomes broken, a semi-permanent repair may be made by the following method.

Remove the axle or spindle *A* by disconnecting the steering arm from *B* and removing the spindle bolt from the hole *C*. Place *A* and its broken member *D* in a clamp with the broken and rough edges *E* in their original places; then drill out a hole and tap it to receive a 7/16 in. S. A. E. bolt of sufficient length to be about equally distant from *A* and *D*. Do not tap threads in *D*, but ream to just sufficient clearance for the bolt.

Draw the bolt up snugly. The wheel may then be replaced after the spindle is connected. The outside cone is adjusted by the locknuts on the threads *F*. To further insure safety, drill a ⅛-in. hole *G*

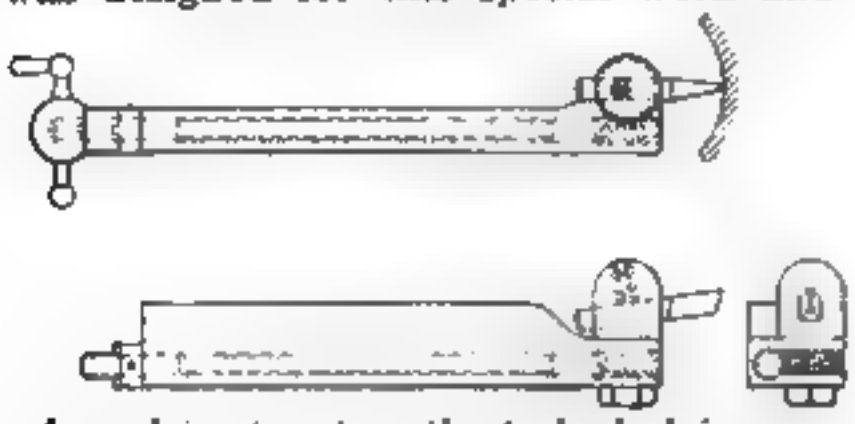


Fastening the end of a broken front wheel spindle to its shank with a standard machine bolt

in the bolt head *H* and insert a long cotter. The hub cap may then be replaced and the car used as before, or until a new part arrives.—P. P. AVERY.

An Adjustable Radius Turning Tool for Lathes

EVERY mechanic has at some time experienced trouble in making a true radius on a lathe. The tool illustrated, was designed for this special work and



A revolving turret on the tool which is controlled by a worm on the rod with crank

has proven a success, especially for tool room mechanics. The holder is made to receive the small high speed steel cutter in a revolving turret controlled by a worm on a shaft through the arm or tool post end of the holder. The shaft is turned by a small crank on the back end.

With this tool the stock may be roughed out, then turned to the radius for which it is set. The setting of the small tool in the turret determines the radius to be turned. This may be done by measuring from the tool point to the curved surface of the turret. Its diameter having been determined the exact radius may be easily obtained.—H. E. ANDERSON.

Protecting the Soles of Shoes with Ordinary Varnish

WITH the ever-increasing cost of footwear, it behooves the user to get as much service from his shoes as possible. To do this the leather must be protected. The soles are the first to suffer, but if the uppers are not impervious to water they will get damp even when the walks are not very wet, and will eventually crack.

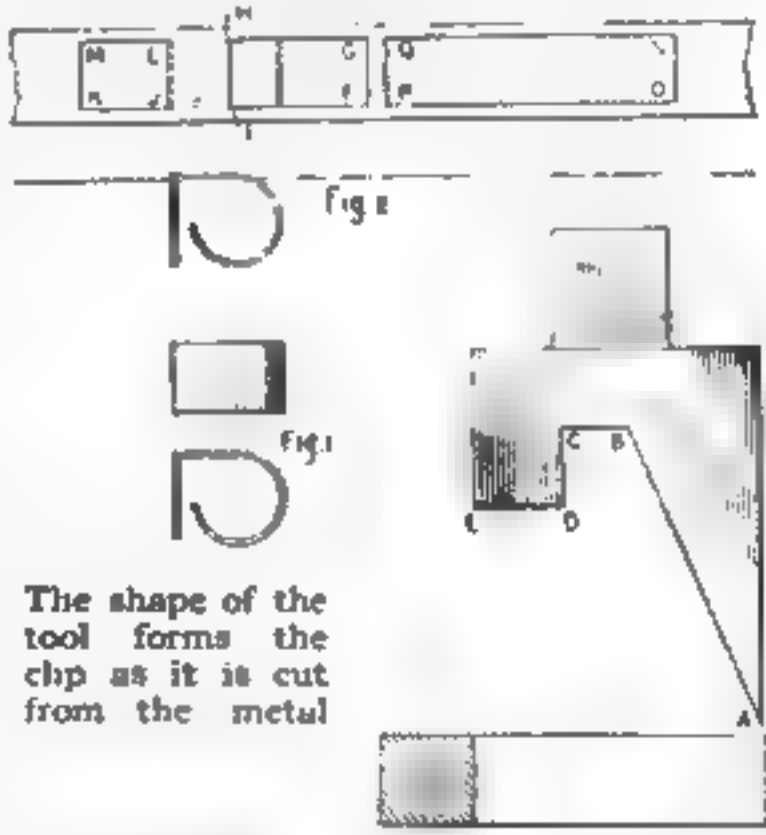
Chamber's Journal is responsible for an article describing how to apply an inferior type of copal varnish to the soles to keep out the water.

The leather must be quite dry and bare when the varnish is applied. New boots should therefore be worn for a day before treatment, so as to remove the black varnish from the soles. The operation is carried out by brushing on the varnish at intervals of half an hour, until the leather will not soak up any more. This condition may be recognized from the surface remaining shiny all over, instead of becoming dull in places. After being hung up to dry for about twelve hours the boots are ready for wear.

A Metal Clip Formed with One Die and One Operation

DUPLICATE parts are quickly made in a punch press by several operations, but how many persons would think that a piece like the one shown in Fig. 1 could be made with one tool in one operation? Such a shaped piece of metal is used as a catch on breast pins, class pins and similar jewelry. The clip is cut and formed from a strip of metal as shown in Fig. 2.

The punch and die for punching and shaping the metal are shown in Fig. 3. The die consists of a piece of steel with a rectangular hole cut in it the width and length necessary to bend the metal in the shape shown. The punch has a



The shape of the tool forms the clip as it is cut from the metal

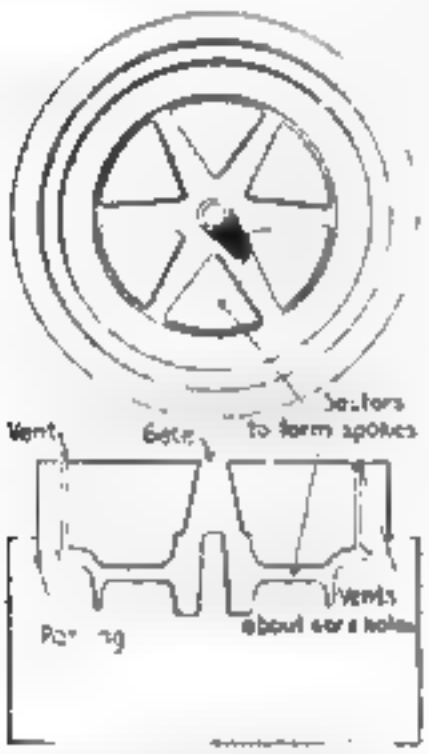
wedge-shaped point *A* which punctures the metal first, cutting along the line *F-G* in Fig. 2. Then as the surface *A-B*, Fig. 3, enters the metal, it cuts along *F-I* and *G-H*, Fig. 2. As the punch cuts these edges, the metal rolls into a curve. The part *D-E* on the punch, Fig. 3, cuts the metal along the lines *J-K*, *K-M* and *M-L* and bends it in the line *J-L*, Fig. 2, then when the part *B-C*, Fig. 3, reaches the metal it cuts out the remainder, leaving the holes *N-O-P-Q*, Fig. 2, in the metal,

and the blank is formed up as required.

The inclination of the slant determines the diameter of the roiled part. Even with the small portion of material wasted, the saving of time in making the parts makes this way an improvement on the old method of cutting them from ribbon stock and forming them in two operations.—S. B. ROYAL.

A Wood Mold for Casting Miniature Car Wheels

TO make a number of cars with which to equip a miniature railway, many wheels just alike will be required. To cast these from metals of low melting temperatures in sand molds, it is necessary to make a great many of them. If care is not taken they will come out rough and will need more work to prepare them for use on the cars. The mold illustrated is one that can be used over and over again. It makes castings all alike and turns them out nicely finished, ready to assemble. The mold is turned in a close-grained piece of hardwood; in the end grain. Two pieces are necessary and the drag or bottom part should be turned with a ledge, and the cope or upper part should be turned to fit in it as shown at the parting line. These surfaces, when turned at the same time that the mold is made, will cause a perfect matching of the parts for each pouring of the metal.



Mold of wood to cast wheels of babbitt metal

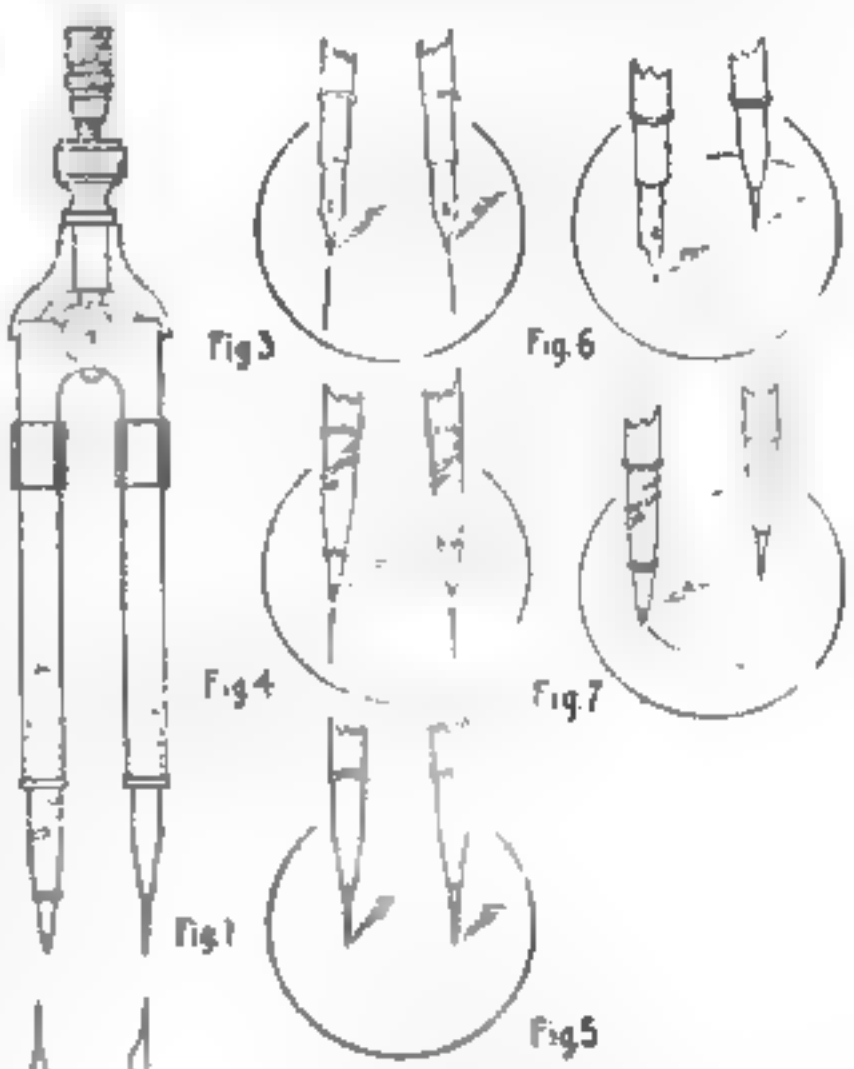
The gate should be turned tapering so that the larger part will be at the casting This will make it easy for the piece to be removed when it cools. Spokes may be formed by placing small blocks, cut to the right shape, in the web of the mold.

A number of castings can be quickly made in this mold from babbit metal. As the hole for the hub is made when the wheel is cast, it only has to be reamed out in order to fit the axle. The draft given to the mold forms the right slope to the wheel surface for rolling on the track. —HENRY WEDDE.

Compasses Made Into a Combination Drawing Tool

PERSONS who do considerable drawing or lettering, sooner or later find the so called railroad pen and railroad pencil an absolute necessity. These are expensive tools, however, and an excellent substitute may be produced cheaply.

Procure two of the compasses such as are here shown and use one pair complete. Pull the points out of the other compass and lay the body away for future use in case of breakage. The points are the only part of the extra pair needed. With



Making five different combinations with one compass

the use of one pair of compasses and the four points, five different combinations are available You can have a railroad pen, a railroad pencil, dividers, and pen compass and pencil compass as shown in the illustrations. Very neat work may be done with this instrument.—ALBERT E. JONES.

Open Canoe Cruising

I.—This article describes the open, canvas covered canoe, its economy in first cost and maintenance and its all-around possibilities as a paddling, cruising and sailing craft

By E. T. Keyser

THESE wartime days have impressed many with the fact which a comparative few realized years ago: that the ability to travel comfortably with light equipment, to keep dry and comfortable in wet and cold and to be able to cook a meal quickly and easily with little fuel and few utensils is an accomplishment.

And this accomplishment, which it is costing Uncle Sam months of time and thousands in money to teach his recruits, is what his first season of cruising gives to the canoeist.

The open canvas-covered canoe, considering its carrying capacity and cruising ability, is, both in first cost and in maintenance, the most economical craft built. It can be purchased so cheaply that it is hardly an economy to build one's own.

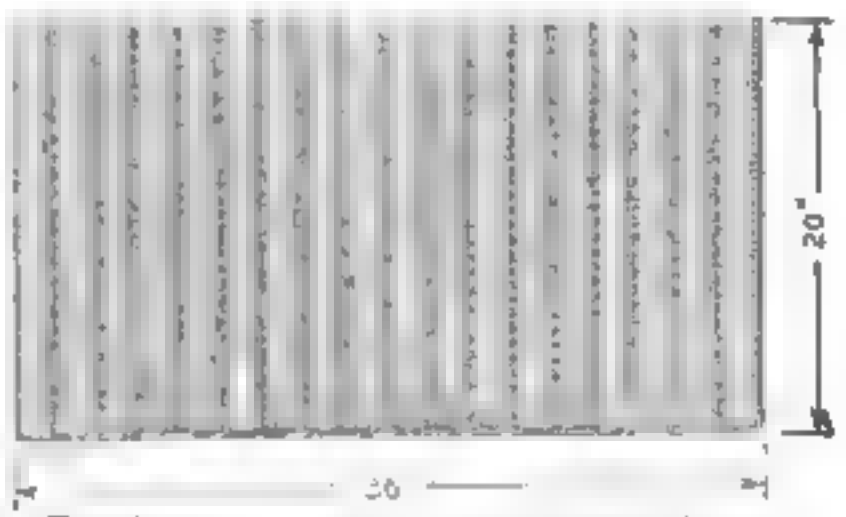
Give it a coat of varnish each season, and a little paint each alternate year and the canoe is good for an indefinite length of time.

For an afternoon on the water, it affords more enjoyment than a row boat, as the paddler can see his course ahead without the neck-twisting process required of the oarsman. As a cruiser, it will go almost anywhere that the small launch or sailboat can navigate and into many nooks and waterways where neither may venture without grounding. As a sailing craft, it affords all the sport and excitement of the small yacht at a fraction of the expense

For all-around paddling and sailing, sometimes single-handed and sometimes with a companion, a 17-ft. canoe is the best. For a small boy who cruises alone, a 15-ft. craft is better because it is easier to handle under paddle in a beam wind, while for continuous double cruising on waters where carriers are absent, 18 ft. is not too long. Generally speaking, however, the 17-footer has been found to be the best all around canoe. It is large enough to accommodate a crew of two with their camp outfit, but it is not too large for one man to pull above high water mark, and it is of sufficient size to carry a satisfying sail area distributed in a double rig.

A model with a little deadrise (that is a midship section coming down to the keel in a slight "V" shape) holds up to the wind better and at slight sacrifice of cargo carrying capacity, as compared with the flat floored model.

By all means choose a canoe with an outside keel which takes the wear and tear which the canvas covering would otherwise receive when beaching the boat or pulling it on and off the float. If possible, see that the craft has wide outside



Two layers of canvas sewed together in parallel lines making pockets for cork filling

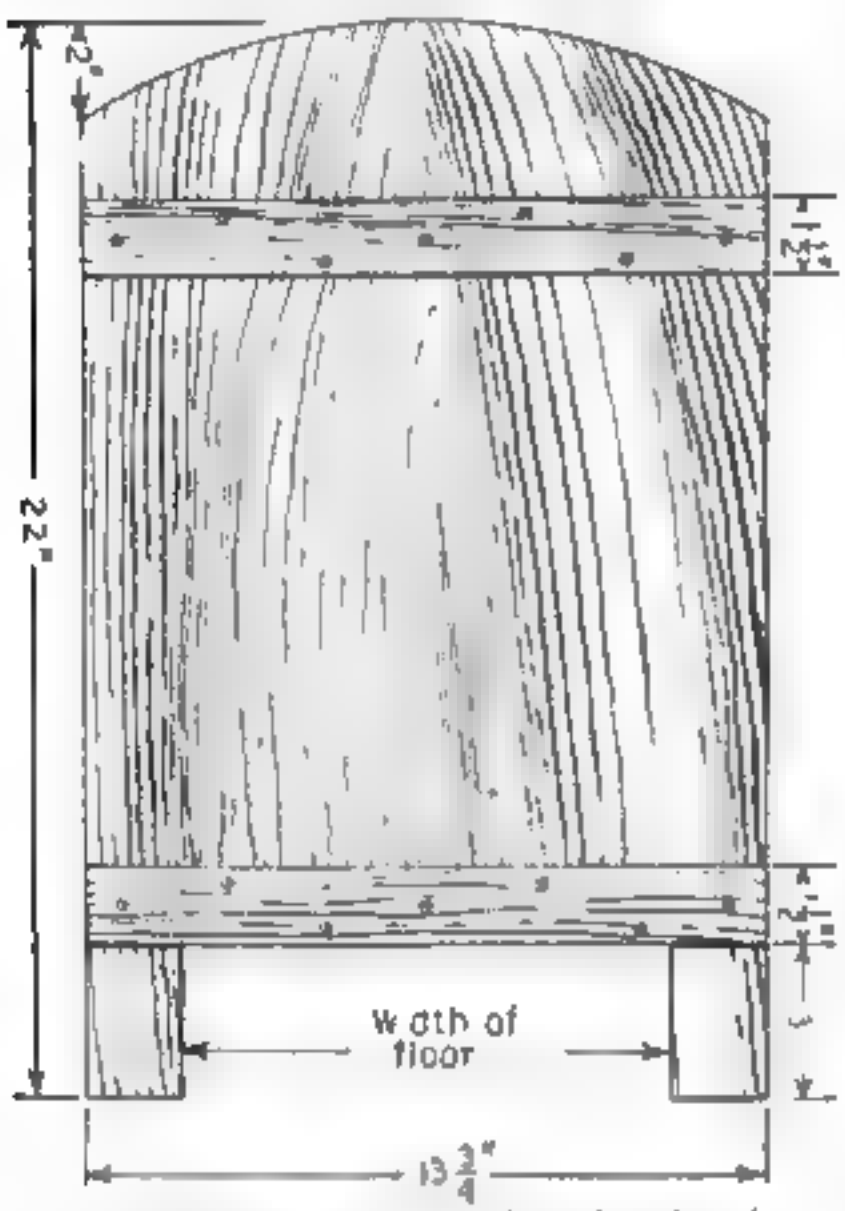
beveled gunwales which throw off a choppy wave that would otherwise climb aboard.

On a 17-ft. canoe, 15-in. decks at each end are long enough. Longer ones add to cost and weight and decrease the seating and stowage space while adding very little to the weatherlines. An open woven seat, 10 in. wide at the bow and one at the stern, should be hung just below the gunwales; this allows one to sit with the knees at a comfortable angle. Some builders drop the seat lower, claiming increased stability, but the first lesson which the canoeist should learn is that seats are to be used only in calm weather. When things rough up one should get down on the floor cushion.

Paddles are made in two general types,

single and doublebladed. Better choose the double blades, square ended, well coppered and 9½ ft. long. They are joined at the center with a heavy ferrule and any time that you want to try single-bladed stunts, separate them and you have two single blades, which will be more comfortable if you have provided yourself with a pair of the short separable handles which the paddle-makers turn out to keep your hands from getting cut and cramped on the ferrule edges.

With the double blade there is no



Dimensions for cutting a board and making a back rest for the seat of a canoe

waste motion, the finish of one stroke places the other blade in position for the next, while with the single blade a recovery stroke must be made. With two singles, unless the paddlers are well matched and practiced in keeping each other's stroke, the rear paddler wastes much energy in keeping a straight course, while with two double blades each paddler equalizes his own strokes automatically.

But the great advantage of the double blade lies in the ability of one man, when paddling against or across a breeze, to head the canoe direct for her destination, without loss of time in recovery or loss of energy in the back sweep required to offset the tendency of the craft to turn in the direction opposite that from which the paddle is operated. In running into a wind, against which one paddler with a single blade would be almost helpless, the setting of the blades at right angles to each other reduces the windage of the idle blade to almost nothing, and a little practice will allow its being turned to take the water without conscious effort. The double blade may be used from the seat or from the floor position, while to get any action from the single blade, the seat position must be kept.

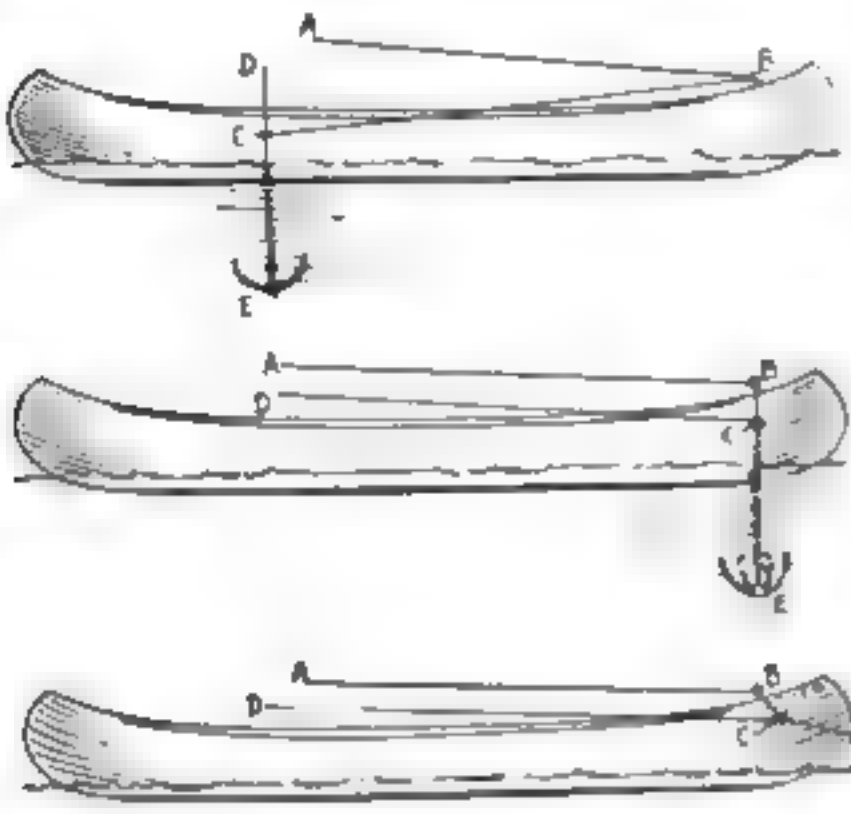
For each cushion purchase one yard of light weight brown waterproof canvas, 40 in. wide. Fold this over on itself with the fold running the long way. Sew the two ends together by machine, if possible, then parallel with the ends and 2 in. apart, stitch across the short way, stitching the two thicknesses of canvas together, being careful to leave the ends of the compartments open so that they may be stuffed with ground cork. When full, baste the open ends together and finish the job on the machine.

You now have a cork-filled waterproof cushion, a trifle less than 20 in. wide and somewhat less than 3 ft. long. Fold this over on itself lengthwise and the result is a canoe cushion about 4 in. thick, which keeps you high enough to be comfortable, does not get wet through readily and, when moist, dries quickly in the sun.

The thwarts are rather low and somewhat too thin to furnish a comfort-support, so you need a couple of back rests. The simplest ones are those cut from ½-in. cherry or chestnut, 22 in. long by 13¾ wide, as shown in the illustration. Be sure that the grain of the wood runs from top to bottom instead of across the back rest, and that the space between the feet is sufficient to clear the flooring strips. Two strips of the same material, each 1½ in. wide, fastened across the back with brass screws will prevent warping if a couple of coats of varnish are applied.

A painter or bow-line with which to tie the canoe is a necessary part of the equipment. An anchor which will allow you to fish or to lie to in some quiet cove without going ashore is also a great convenience. A four-pound folding anchor of the

"Dirigo" pattern will hold the canoe against a strong current or breeze and when folded has no projecting points upon which to step or which will puncture the planking. You cannot walk up to the bow to hoist the anchor as you could aboard a rowboat, but I have found the following rig effective for the purpose.



An anchor is a great convenience, especially when it is attached as shown for handling it entirely from the seat of a canoe

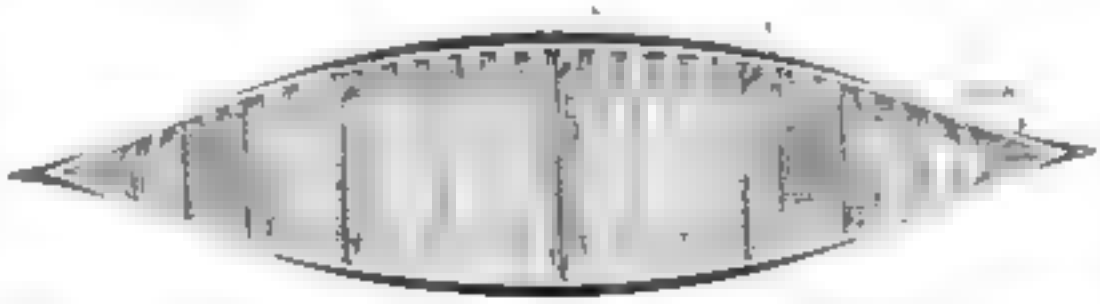
From a ship chandler, get a *lignum vitae* bull's-eye with an eye diameter of ½ in. Then get a brass screw-eye whose interior diameter is that of the outside diameter of the bull's-eye at the bottom of the groove which surrounds it. Using a cold chisel, carefully open the screw-eye sufficiently to insert the bull's-eye, then with the aid of a vise, seat the screw-eye firmly in the groove of the bull's-eye. Set this device crosswise in the center of the forward deck and run a ¼-in. cotton rope through it, the rope's length should be twice that of the canoeist's distance from the bow when occupying the rear seat. This is shown at *A*. *B*. *C*. At *A* tie a knot which can not pass through the bull's-eye, at *C* fasten a galvanized snap hook through which the anchor line runs easily.

Holding one end of the short line at *A*, the canoeist snaps the galvanized snap *C* over the anchor line, *D E*. Then pulling in on *A*, he allows *D E* to pay out until the anchor is at the bow as shown in the second illustration. Then *A* is belayed to a cleat and *D* payed out until the anchor rests on the bottom as in the third illustration when the anchor rope *D E* is also belayed.

To pull up the anchor, *A* remains belayed while *D* is pulled in until the anchor is in the position shown in the second illustration. Then *A* is uncleated and further pulling on *D* brings the anchor back to the canoeist as shown in diagram *I*. When the anchor rope is unsnapped, the anchor is folded and stowed.

With this rig, which is very simple, one may anchor at will in almost any sort of weather and shorten or lengthen the cable to suit varying conditions without leaving one's seat. Do not be afraid to use a good long anchor line,—50 ft. will be none too long—and will allow the anchor to hold against a current or breeze which would cause the canoe to drag if a shorter cable were attached.

On calm waters, in calm weather, or with a moderate stern breeze, a single-handed canoeist with no luggage aboard, should turn the canoe stern first and sit on the bow seat facing the stern which is now the bow or on a cushion leaning against thwart 1. From either position the canoe trims well with but one man aboard, the chance to change from one position to the other at will is very restful and adds greatly to one's endurance on a fairly long run



Layout of the ordinary canoe showing the relative positions of the seats and the thwarts. Seats are for calm weather use

When running into a strong breeze or with a quartering wind, which catches the bow and swings it around, sit in front of

thwart 3 facing the bow. When the wind becomes heavy and almost all one's energy is required to keep the canoe on her course, crawl forward in front of thwart 2. This allows the stern to rise up and, by catching the force of the wind, to act as a weathervane, making the canoe tend to point into the wind of her own effort, releasing all of the paddler's strength for use in making progress forward.

I would not suggest that a canoeist should deliberately start out on a long hike against a heavy wind or with a quartering gale blowing, but weather conditions sometimes change without notice, and this scheme proves mighty helpful when one does get caught.

With two aboard, use the canoe bow first, sitting on either the seats or the floor as desired, the heavier person occupying the after position. If weights are about equal, the better paddler should sit aft.

The bow seat is best for a woman when she is one of the crew, as she can paddle and rest, rest and paddle as she sees fit without interfering with the management.

In fairly rough water one can run directly ahead of rather high waves without discomfort, if careful not to let the canoe swing from her course and get into the trough. Surprisingly high waves may be run into bow first, if the speed of the canoe is checked enough to reduce plunging the bow under the white caps. A heavy beam wave is bad. It has a tendency to slap against the side and slop aboard. Therefore it is better to hug a windward shore when possible or, if in open water, to make a series of tacks, the same as if sailing, first quartering against and then from the waves.

Progressive positions of single blade paddle

What has been said in regard to speed reduction when meeting bow waves in open water is still more true when one is running rapids in streams or going through tide rips. In both these latter cases, the water itself and not the *form* of the wave is what advances and, unless the canoe is allowed but just enough speed for steerage way, there will be a strong tendency for the bow to ship water.

In discussing the paddle, emphasis has been placed on the desirability of the separable double blade. There are times, however, when the canoeist will desire to separate it into singles, so a word regarding its handling will fit in here.

With two paddlers, each using a single, it is the part of the stern man to keep the course, which may easily be accomplished if both are able to match each other's stroke. Otherwise the rear paddler wastes effort in keeping up his end or retarding his stroke to match the bow paddler's.

With one paddler only, using the single blade, a peculiar stroke is necessary to maintain a straight course without shifting the blade from one side of the canoe to the other as shown.

The arrow shows the direction of the stroke while the dotted arrows indicate how the outside edge of the blade is turned as the stroke finishes.

For a little more than one-half the stroke, the blade remains at right angles to the canoe, then the outside edge is brought forward gradually swinging the blade into the last position shown, which swings the canoe in an opposite direction from which the commencement of the stroke points it

As will be seen, the first part of the stroke furnishes the power to send the canoe ahead, the latter portion is devoted to converting the swing of the canoe from a left hand into a right hand direction, and has very little propelling power. As one becomes more expert, the entire stroke may be taken with just enough angle to the blade to offset the natural swing of the canoe away from the paddle, and one may make the canoe describe a circle, the center of which is on the side on which the paddle is used. The diagram illustrates the movements when the paddle is used on the right hand side of the canoe; when the paddle is used on the left side the turning of the blade is reversed.

Before closing this chapter on handling, I want to register a few emphatic "Don'ts." Don't step anywhere but in the center of the floor when entering or leaving the canoe. Don't rest part of your weight

on a float or dock and part on the gunwale when getting on or off—rest your weight equally on both gunwales. Don't stand up in the canoe. If you must change your position while afloat, rest your weight on both gunwales, keep low down and slide to your desired place. Don't try to paddle from the seats when it begins to get rough—get down on the floor and get there gently. Don't leave the canoe exposed to sun, rain and wind, keep her under cover when not in use.

(To be continued)

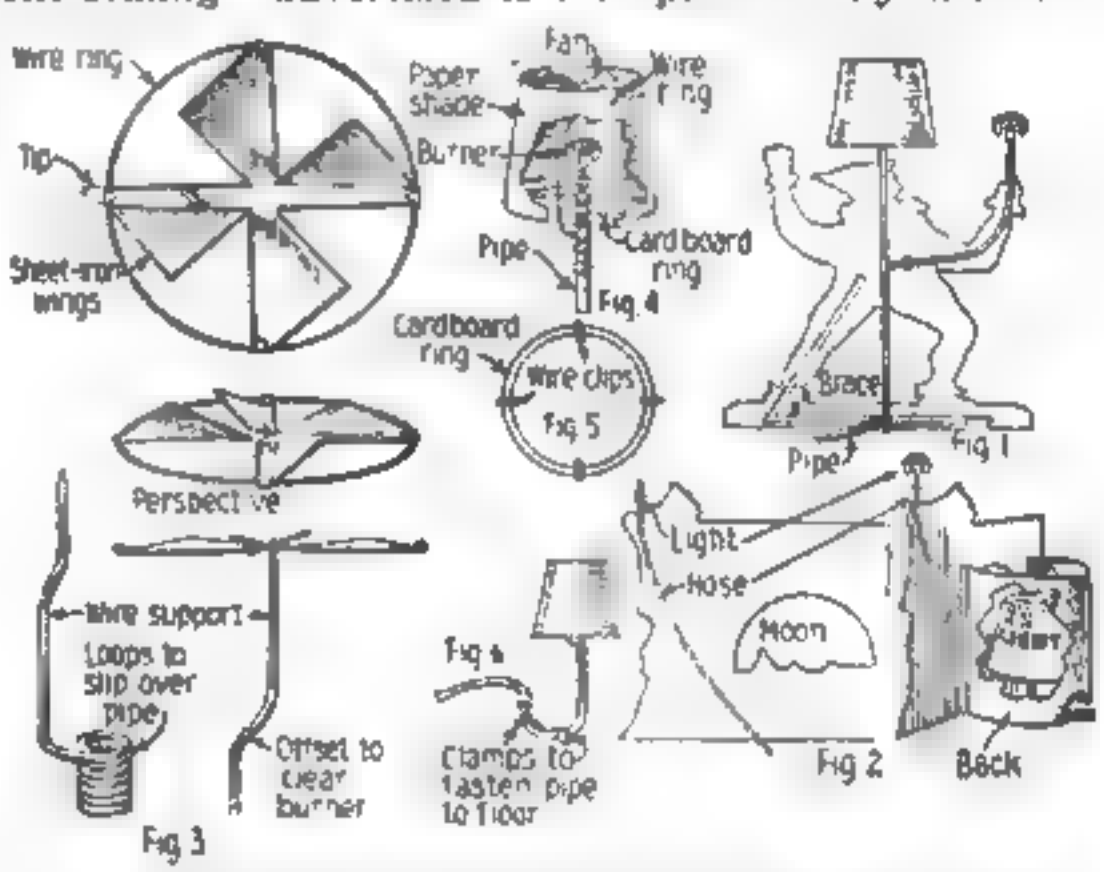
An Attractive Heat-Driven Window Display of Gas Fixtures

NOT long ago an establishment dealing in gasfixtures, displayed in its window a gaily colored pasteboard clown holding in one hand a well-known type of gas light, while apparently balancing on his nose a lighted lamp, the colored shade of which revolved continuously. A back view of the figure showing the piping and wood braces is displayed in Fig. 1. A gas hose from a convenient stop and connected to the brace pipe, furnished the illuminant and motive power.

The latest window display, advertising this same light, is more spectacular than the first. Standing at one side of a moonlight scene, showing a large moon rising back of the house tops, stands a gaudily dressed Oriental, who points toward the face of the moon, across which illuminated words move constantly. In each display, the ascending current of hot air, generated by the gas light, is the motive power. The mechanism is just an adaption of the old hot air wheel the boys used to hang over the cook stove.

The wings are attached to a wire ring, Fig. 3, which is slipped into a deep paper shade, fitting into the shade snugly near the top as shown in Fig. 4. The bottom of the shade is kept in shape by a cardboard ring secured with wire clips which pass through the shade. See Fig. 5. A wire support, looped at the bottom to slip over the gas pipe, supports the wheel and shade. A small depression in the exact center of the wheel fits over the pointed end of the wire support. Point and depression are gaged to a nicety as is evidenced by the even balance and smooth movement of the shade.

The display just described requires the lamp to be concealed by a semi-circular black cardboard screen. This cuts off the light except at the top and front. The light, projecting through the cut-out, words in the shade, glows through the tissue paper face of the moon, and the colored design on the shade produces an effect of moving clouds across the face of the moon. As in the clown display, the light advertised is also prominently shown.



A heat-driven wheel for turning lettered signs and the arrangement for illuminating the parts of the scene

Methods of anchoring the lamp, also a rear view of the display, are shown in Figs. 2 and 6. Judging from the improvement in the second display, the use of gas generated hot air, and the simplicity of the mechanism necessary to utilize it, offers a wide field for attractive window displays.—JAMES M. KANE.

Permanently Fastening Joints Held with Screw-Unions

IF you desire to fasten pipes or pipe fittings together permanently, thoroughly clean the parts to be fastened and cover the threads with a strong solution of salt and water. The salt will rust the threads together, fastening the parts.

Little Ways in Which You Can Save Gasoline

DO not use gasoline for washing or cleaning; use kerosene. Do not allow your automobile engine to run when car is standing. Have your carbureter adjusted to use leanest mixture. See that bearings run freely and are well lubricated. Keep tires fully inflated. Protect the radiator in cold weather. Change gears rather than climb hills with throttle wide open. Do not use your car needlessly or aimlessly. Do not do stunts.

—

Discovering a Card Chosen but Not Taken from the Pack

FIRST notice the bottom card, then take the pack in the left hand, holding it with the fingers on one side and the thumb on the other. Secretly draw down the bottom card about ½ in. Let the right hand approach the pack, and with the first and second fingers draw down the cards, one by one, ½ in., beginning with the top card and so on, inviting your audience to stop you at any card they choose. This is clearly shown in the illustration. The thumb of the right hand has remained beneath the pack in contact with the bottom card. The thumb should have been previously moistened slightly so as to adhere to the bottom card. When your audience has indicated the card at which they desire you to stop, draw all the cards so far selected completely away from the pack, drawing with them also, unknown to the audience, the bottom card. If this is done quickly it is impossible to detect that the bottom card is drawn away with the upper cards. Since, however, you know the bottom card, you can disclose it at your leisure by some means or other. It is needless to say that the bottom card is really supposed to be the last card at which you stopped in going through the pack.

Secretly draw out the bottom card a short distance

The effect of the foregoing trick may be greatly enhanced by shuffling the pack after having noticed (secretly, of course) the bottom card. This apparently does away with any previous arrangement. The object of the shuffles is to leave the pack, or certain cards in it, exactly in the same position as they were before. Shuffles of this kind, which leave certain cards undisturbed, are known as false shuffles. There are many ingenious methods for shuffling a pack in this manner; but for this purpose two methods are described which leave the bottom card still at the bottom, or the top card at the top.

Take the pack in the left hand in the ordinary way and shuffle it with the right, leaving a number of cards alternately at the front and rear of the pack; that is, leave some at the top, then some at the bottom, again some at the top, and so on, taking care that the last batch shall always be at the bottom of the pack. This will always leave the bottom card at all times in its original place.

Another method is to divide the pack into two equal parts, being careful that the card known to you is on the bottom of one of these packs, and keeping in mind which pack has this card. Lift the corners of the two packs and let the cards fall alternately as nearly as possible, the corners overlapping, so that, when the shuffle is finished the two packs form one pack. The only thing to watch closely is to see that the card known to you falls on the table first. This leaves that particular card at the bottom of the pack.—HEREWARD CARRINGTON.

Rejuvenating the Ribbon on an Adding Machine

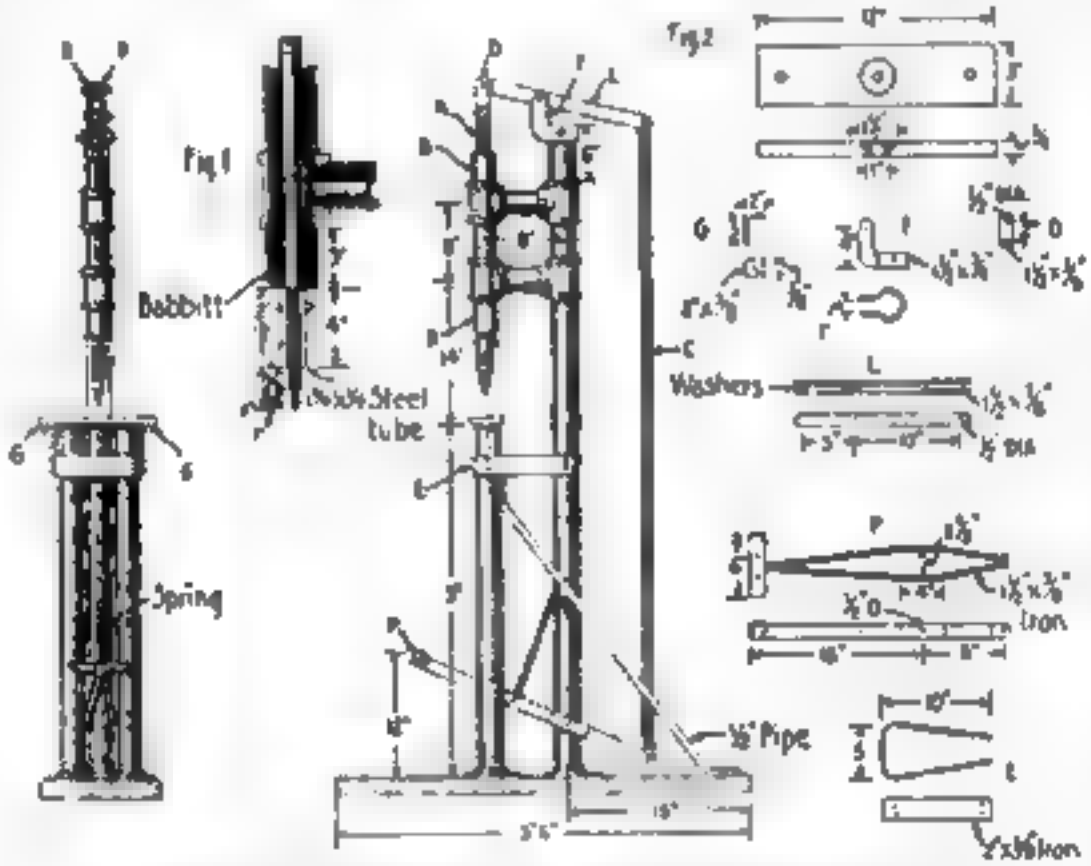
THE writer was unable to secure, without considerable delay, the proper bichrome ribbon for an adding machine. The one in use, though not badly worn, was too dry to give a satisfactory impression. As the fresh color of the ribbon indicated that the pigment was still in the fabric, it was decided to see if an application of oil would not loosen it up. This was tried, and after two or three applications of machine oil the ribbon worked as well as ever and continued to render good service for several months.

Tricks of the Trade

An entire homemade punch operated by foot power. How to make laminated wood pulleys

A Foot-Power Punch Press for Light Work

THIS foot-power punch press was made almost entirely of 2-in. pipe and fittings, built on a wood base 2 in. thick, 12 in. wide and 3½ ft. long. The ram *A* consists of a piece of 1-in. cold rolled steel 2 ft. 1 in. long. The bushings *BB*, in which the ram works, are short pieces of pipe lined with babbit, as shown in the detail Fig. 1. The end on which the socket is fitted is turned to a diameter of ¾ in. The socket is made from a piece of steel tube 1 ½ in. in diameter with walls ¼ in. thick. The punch is turned from tool steel ¼ in. in diameter to the required size, leaving enough shank full size to fit in the socket. The punch end is then tempered. The connecting arm *C* between the foot lever and the lever at the top consists of a ½-in. pipe flattened on the ends to fit between the parts of each lever. This piece is measured and fitted into place after the other parts have been assembled. The foot lever should be 12 in. from the base when the punch is raised as high as it will go in the bearings.



Punch press made of pipe and fittings, which are set on a wood base. The punch is operated with a foot lever

The die, Fig. 2, is made of a good grade of iron and fitted with a hardened steel bushing. Several of these bushings may be made with holes of varying sizes so that when the punch sizes are changed the bushing to match them may be changed also.

If it is desired to use the punch on large sizes of metal it will be necessary to make the die and holder in one piece, and of hardened tool steel. The die is securely fastened in the die-holder with two ½-in. cap screws which fit into slots in the angles *GG*.—C. A. BUTTERWORTH.

Homemade Laminated Pulleys for the Small Shop

IN practically every shop cone-pulleys and plain pulleys are needed at some time or other, but for the mechanic of ordinary means they are expensive to buy. They can be turned from solid blocks on a lathe, but a lathe is not always available and even then the cost is considerable. By the following simple method pulleys which will not warp or split, and which will give as good results as the expensive pulleys, can be made at practically no expense.

Thin wood is easy to get and is easy to cut, and from this the pulleys are made. Hard wood should be used if it can possibly be obtained. On a scroll saw, cut the wood into circles a little larger than the size of pulley wanted. Cut enough disks to build the pulley up to the right thickness. In each disk, drill a hole for the shaft, which should fit tightly.

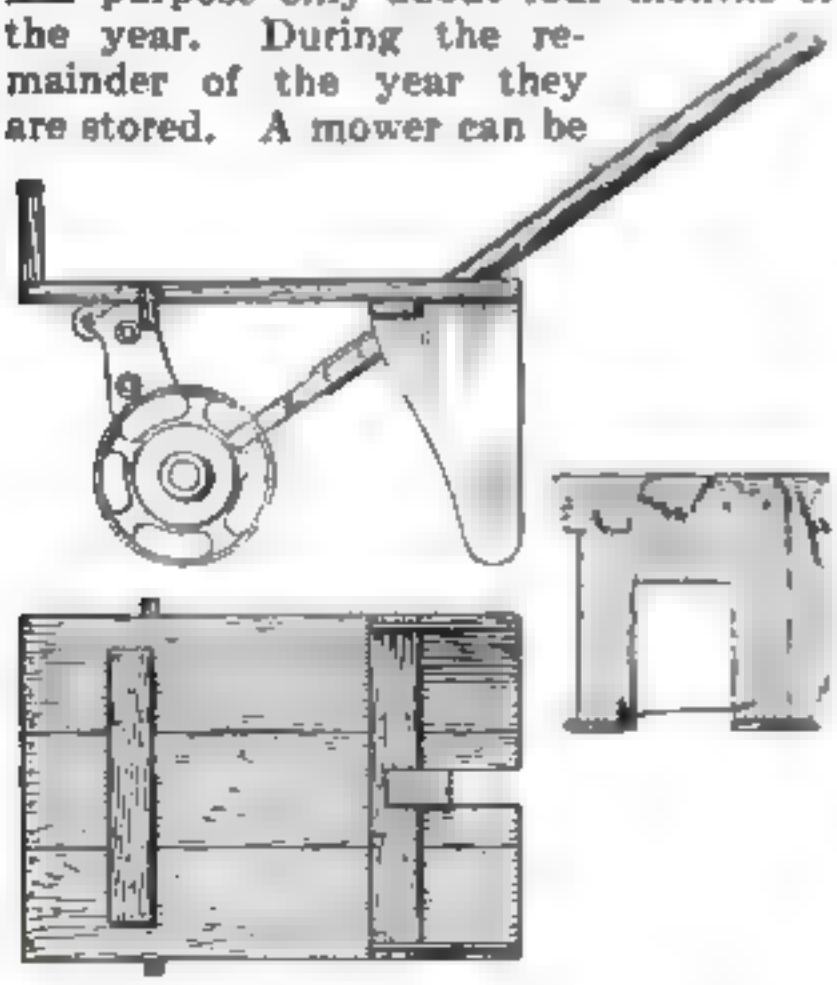
Glue the disks together with the grain of each running in a different direction; allow a little extra thickness for truing up afterwards. Be sure the surfaces to be glued are free from all dirt and grease. Use good glue; if the common kind is

used, it should be applied while it is very hot. Clamp the disks together with stiff blocks and heavy bolts, putting one bolt through the shaft hole and several around the outside. The bolts should be tightened as much as possible so that the disks will be pressed together very tightly. Allow the glue to dry for at least twenty-four hours in a warm—not hot—place. Put in screws, countersunk from both sides for additional strength and to prevent the glue from loosening. The pulley can be trued up when running on its own shaft. Make the belt face of the pulley slightly crowned, because if the face is flat, the pulley will run off. The surface should be made as smooth as possible, as the smoother it is the better the belt will hold.

The only difference between making a cone pulley and a plain one is that the steps are made separately and then glued or screwed together.

A Lawn Mower Converted Into a Handy Truck

LAWN mowers serve their original purpose only about four months of the year. During the remainder of the year they are stored. A mower can be made to serve two purposes with the board attachment shown. It is well known that pushing an inverted lawn mower throws the gears out of mesh. The board attachment may be easily made and put on the inverted mower so that it may be used for hauling small loads or sacks of grain.

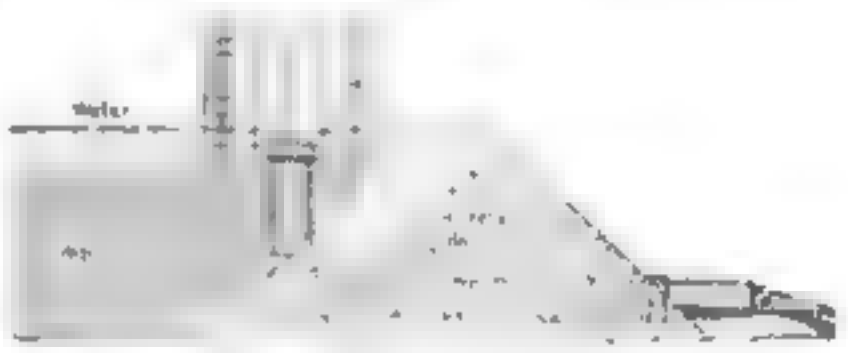


An inverted lawn mower equipped with a board platform to make a truck for small loads thus making it useful in the winter

The size of the board depends on the size of the mower. The manner of attaching it to the inverted mower is clearly shown.—EARL R. GASKILL.

A Dam to Prevent Top Soil from Washing Away

A SIMPLE and inexpensive method of preventing a field from becoming cut up by gullies is shown in the drawing.



Cross section view of a small concrete dam which keeps the soil from washing away

Some lengths of sewer pipe and a few hours work in the building of a small concrete dam across each gully is all that is required. The drawing shows how the dam operates.

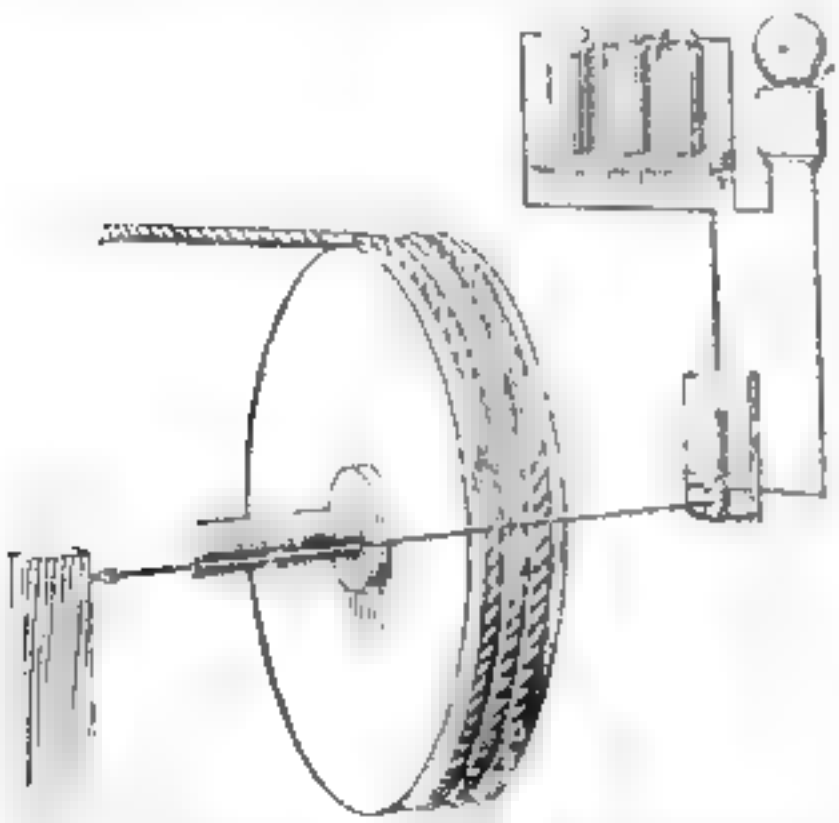
It is a good plan to set three or four posts around the opening or the inlet and then wrap them with common mesh fence wire so that all rubbish and trash will be kept out of the sewer pipes. In laying the pipe be sure and set the curve or elbow on a firm bed of stones and also be sure that the whole length of pipes is on a solid footing.

The concrete dam is preferable although hard clay has been used for small places. The dam catches the top soil washed from the fields and also stores up the surplus water. The richest part of the soil is the part that washes away during heavy spring rains. Some practical method of preventing this great loss is well worth the farmer's attention if the producing power of the fields is to be conserved or increased, and the method of surface drainage suggested above is at once practical, simple to install, inexpensive and effective.—W. E. FRUDDEN.

The Amateur Electrician
And Wireless Operator

Electric Alarm Signal for Transmission Ropes

TRANSMISSION ropes in continual service eventually wear so that a break begins. The simple electric device



A broken strand in the rope strikes the wire and makes an electric contact

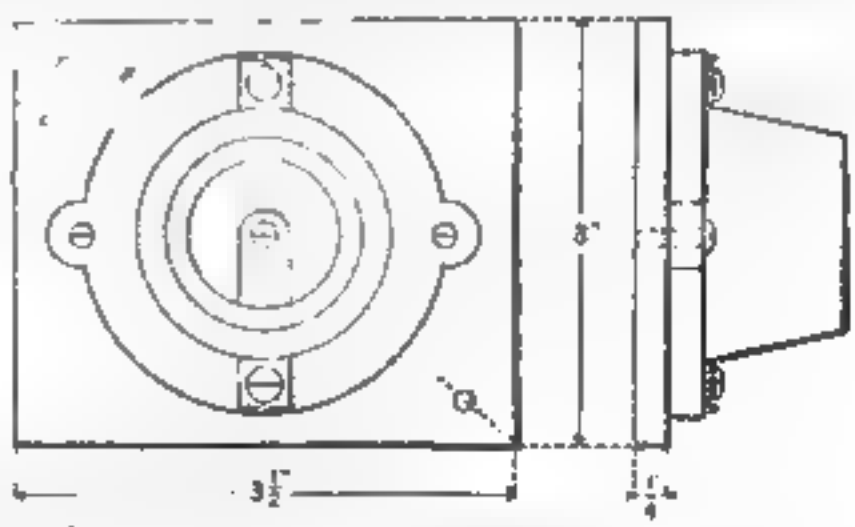
shown sounds an alarm as soon as the first strand breaks, or begins to unravel. Immediate repairs can be made before the break becomes a serious one that would necessitate a new rope.

To Prevent Leather Belts from Slipping on Pulleys

IN the machine shop, slipping belts are a source of constant annoyance, and tightening does not always remedy the difficulty. Powdered resin is bad for the belt, though unfortunately it is widely used. Its tendency is to dry and crack the leather. In place of resin, whiting can be used. Sprinkle it sparingly upon the inside of the belt. Continued use of this substance has demonstrated that it is the least harmful application. Resin is difficult to get out of the leather; whiting may be wiped off or washed out with water. The best results are obtained when the whiting is applied once a week. A frequent cause of slipping is the failure to lag the iron pulleys with a covering of leather. If this detail is attended to, it will, to a great extent, do away with slipping.

Mounting a Porcelain Base Electric Light Receptacle

EXPERIMENTERS and students who are using porcelain receptacles for experimental and practice work, find that they very often break off the porcelain lugs which are used to hold the receptacle to the wall. A very good and cheap method of eliminating this waste is to mount the receptacle on a piece of ¼-in. fiber, 3½ in. by 3 in., with 8-32 machine screws, as shown in the illustration. The two holes in the corner of the fiber base are used to hold it to the wall, taking the

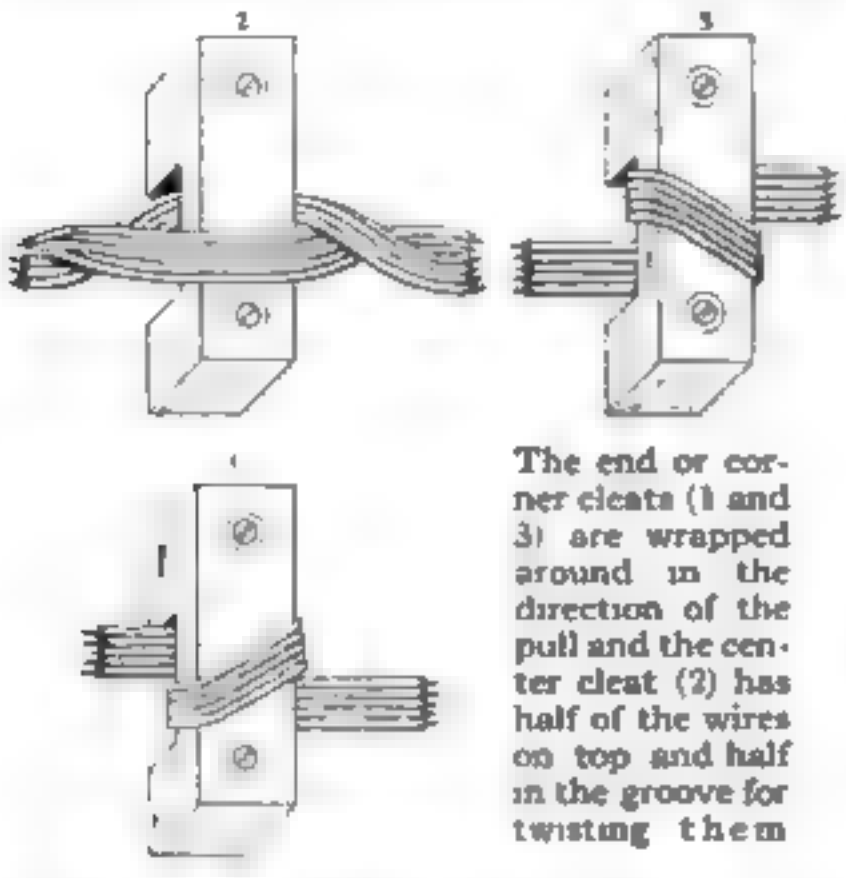


With the fiber base attached the porcelain socket is protected from breakage

place of the holes in the porcelain. In this way, the receptacle is guarded against breakage.—WALTER B. WEBER.

Tightening Electric Wires Under Wood Cleats

EVERYONE realizes how difficult it is to tighten a number of wires under wood cleats. Using the method shown in the illustration, it becomes a very simple matter. The wires on the end or corner cleats of a run should be wrapped around and securely fastened to the cleats. The center cleat should have one-half of the wires on top and the other half in the groove. The cleat is then turned round and round until the wires become a tightly twisted cable. Care must be taken, however, not to stretch the wires too much as it is possible to break them. The cleat is then screwed down, holding the wires in this tight cable-like form.



The end or corner cleats (1 and 3) are wrapped around in the direction of the pull and the center cleat (2) has half of the wires on top and half in the groove for twisting them

Mounting a Glass Plate Without Drilling Holes In It

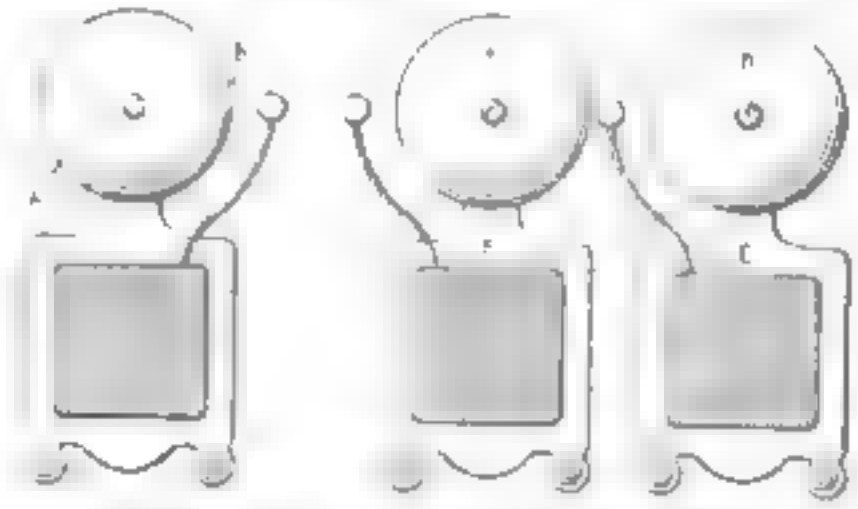
THE method herein described for mounting a glass plate is much simpler than drilling, and in most cases it is to be preferred. The procedure may be utilized by the amateur for plates not having a greater diameter than 2 ft.

To mount the plate, it is necessary to place it upon marked paper that has been made for template, to enable one to determine the center. Over the center must be pasted small circles of a fibrous brown paper, one on each side of the glass. The circles must be exactly the same size as two wooden cheeks previously made from a cotton reel sawn in half. The paste essential for satisfactory results contains the following ingredients: One teaspoonful of flour; two ounces of water; and three grains of bichromate of potash. The potash should be finely pulverized, and the ingredients must be thoroughly stirred before placing them over a flame. The mixture is brought to the boiling point in a suitable vessel. It is kept in the dark when not in use. The glass disk on which is pasted the paper circles, is placed in the sun for a few hours. This treatment insures the best result as the sun's rays set up a chemical action in the bichromate, rendering it insoluble, so that it cannot readily be detached from the plate. When dry, the wooden cheeks may be glued to the paper circles. First add a few grains of the potash to the glue to prevent its being affected by dampness. A little care will secure excellent results.—HERMAN NEUHAUS.

Changing the Tone of an Electric Bell by Sawing It

A VERY good method of changing the tone of a bell is to saw a slot *A* in the gong *B* with a hack saw; the bell will then have a tone similar to that of a cow bell. The deeper the slot, the duller the tone.

Another method of changing the sound of a bell, is by placing two bells close together so that the hammer of bell *C*,



Changing the tone of a bell by sawing a slot in the gong and a double gong arrangement, thus distinguishing them

on its forward stroke, strikes the gong *D*. On its backward stroke, *C* strikes the gong *E* on bell *F*, making it sound like a telephone bell. When bell *F* is rung, the hammer only hits its own gong, giving the ordinary sound.

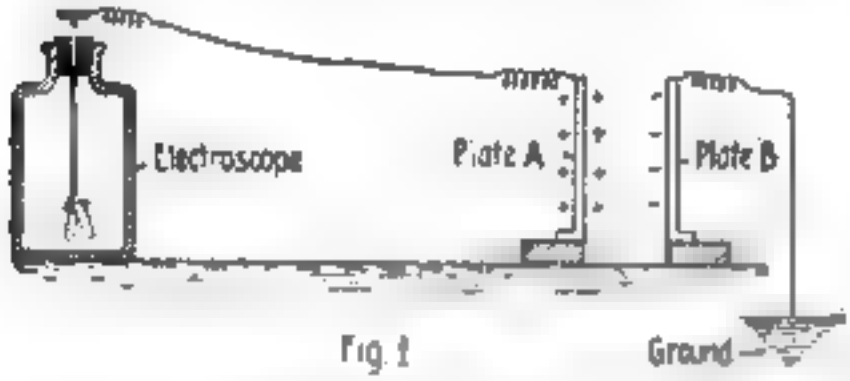
Electrical Devices and How They Work

IV. –Theory and Fundamental Principle of the Condenser

A condenser consists of a material that has the property of holding a charge of electricity

By Peter J. M. Clute, B. E.

IF a metal plate *A* is mounted on an insulated stand and connected with an electroscope, as in Fig. 1, and if another plate *B*, similarly mounted, is connected to the ground, then, when an electrostatic charge is placed on *A*, it will be



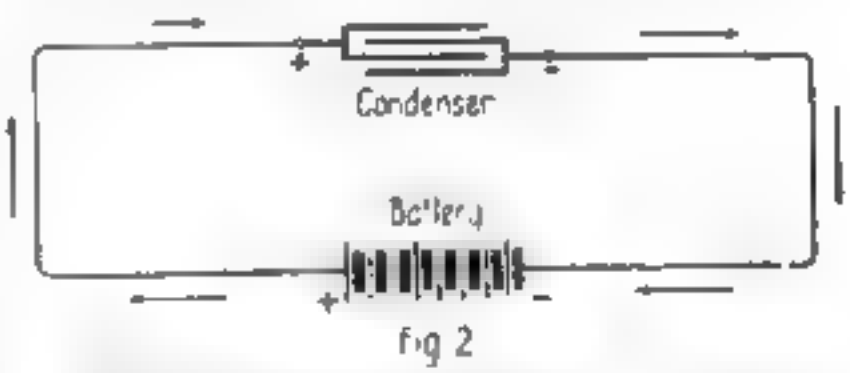
A diagram illustrating the action of an electrostatic charge between two plates

observed that the leaves of the electroscope collapse as *B* is brought close to *A* and diverge farther as *B* is moved away from *A*. This merely shows that the potential of *A* is lessened when the distance between the plates is diminished, in spite of the fact that the quantity of electricity on *A* has remained unchanged. If additional charges of positive sign are conveyed to *A*, it will be found that many times the original amount of electricity may be placed on it when *B* is in proximity to it, before the body regains its original potential.

It can be stated, therefore, that the capacity of plate *A* for retaining electricity is very greatly increased by bringing near it another conductor connected to earth. It is evident from this statement that the capacity of a body is measured by the amount of electricity that can be put upon it in order to raise its potential to a certain point. Under these circumstances the charge on plate *A* is said to be bound by the opposite electricity on plate *B*.

An arrangement of this sort consisting of two conductors separated by a nonconductor or dielectric, as air, mica, rubber, or paraffined paper, is called a condenser. When the conducting points are very close together and one of them is grounded, the capacity of the system may be thousands of times as much as that of a single plate. If these two plates are connected to the two terminals of a battery, or other source of electrical energy, as shown in Fig. 2, they acquire equal and opposite charges of electricity, corresponding in sign to the terminals to which they are connected. The final constant difference in potential between the two plates is that of the two terminals; or, what is the same thing, each plate assumes the potential of the point to which it is connected. If the leads to the condenser are of negligible resistance, this difference is produced almost instantaneously, that is, the condenser charges in a negligible time.

The flow of current will be at its maximum at the instant the E. M. F. is applied, but will rapidly fall off, so that in a fraction of a second, the current will practically have ceased flowing, and the condenser will be charged. This condition will exist as long as the condenser is connected to the battery, or other electrical source. The condenser acts as if it had



Two conductors separated by a non-conductor within a circuit makes a condenser

acquired a counter E. M. F. as it becomes charged, thus bringing into play a tendency to retard the flow of current. This counter effect increases as the condenser is charged, until it becomes equal and opposite to the E. M. F. of the battery. If the battery be disconnected and

the terminals of the condenser connected together, as in Fig. 3, the charge will flow out and will result in a current of short duration. This current is at its maximum when the terminals are first connected, but it soon dies down to zero value.

When a condenser is charged, the potential difference at the terminals does not instantly come to a maximum value; in other words, a certain time elapses before the condenser reaches full charge. This apparent absorption is due to an action on the dielectric surface. At discharge, a certain time also passes before the previous charge is entirely removed; some of the charge has been absorbed into the dielectric, which charge is called residual. A condenser exhibiting this quality possesses residual absorption. Hence, the actual capacity of a given condenser is not definite, depending as it does upon the

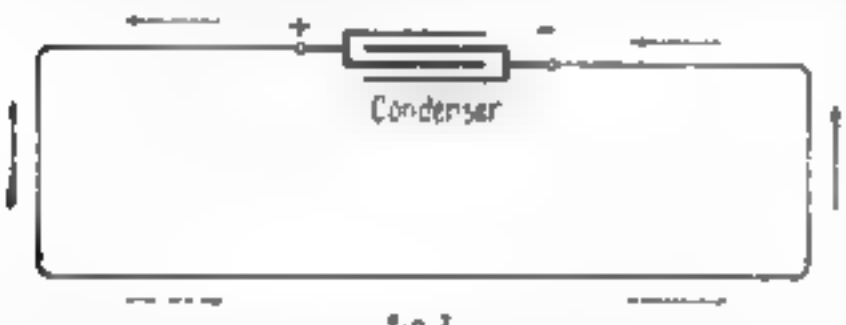


Fig 3

With the battery removed and the circuit made complete the charge soon flows out

amount of residual absorption and leakage.

Condensers may be connected in parallel, as in Fig. 4, or in series, as shown in Fig. 5. The combined capacity of two condensers in parallel is equal to their sum. If C_1 and C_2 are the capacities of the two condensers illustrated diagrammatically in Fig. 4, their combined capacity will equal $C_1 + C_2$. This is true for any number of condensers connected in parallel; hence, if a number of condensers are connected in parallel, their combined capacity is equal to the sum of all the capacities.

The combined capacity of two condensers in series is equal to unity divided by the sum of the reciprocals of the two capacities; or, referring to Fig. 5:

$$C = \frac{1}{\frac{1}{C_1} + \frac{1}{C_2}} = \frac{C_1 C_2}{C_1 + C_2}$$

This rule applies to any number of condensers in series.

Condensers are made by taking a large number of tinfoil sheets and separating them by alternate sheets of paraffined paper, mica, or other insulating material. The whole mass is pressed tightly to-

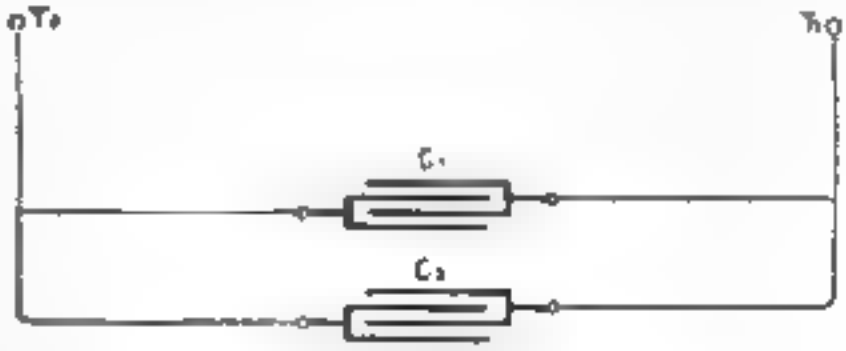


Fig 4

With condensers connected in parallel their combined capacity is equal to their sum

gether, one set of sheets being connected with one terminal and the alternate set with the other, as illustrated in Fig. 6. It should especially be noted that no electrical connection exists between the sets of plates connected to the two terminals, since it is this property of inductivity of the dielectric that enables the condenser to store up such an enormous charge of electrical energy.

The quantity of electricity held by the condenser may be made greater by increasing the charging *E. M. F.* and is directly proportional to this *E. M. F.* In addition, it is found that for a given voltage, the quantity of electricity which the plates will acquire depends upon their size, their separation, and the dielectric or insulation between them. The quantity of electricity held by either plate of a charged condenser, represented by Q, may be written equal to the product EC,

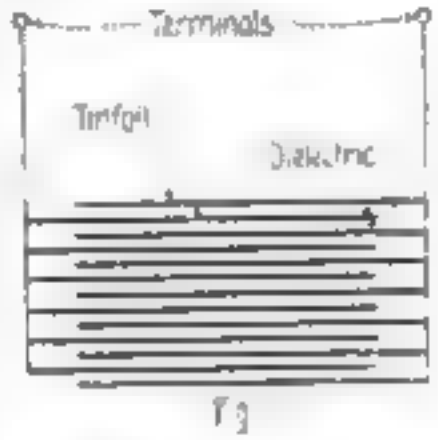
Fig 5

Also if the condensers are connected in series their combined value equals their sum

where E is the charging *E. M. F.* and C is a constant factor which takes into account the construction of the condenser. This factor C is known as the capacity of the condenser.

Thus, we may write, $C = Q/E$, or the capacity of a condenser is the quantity of

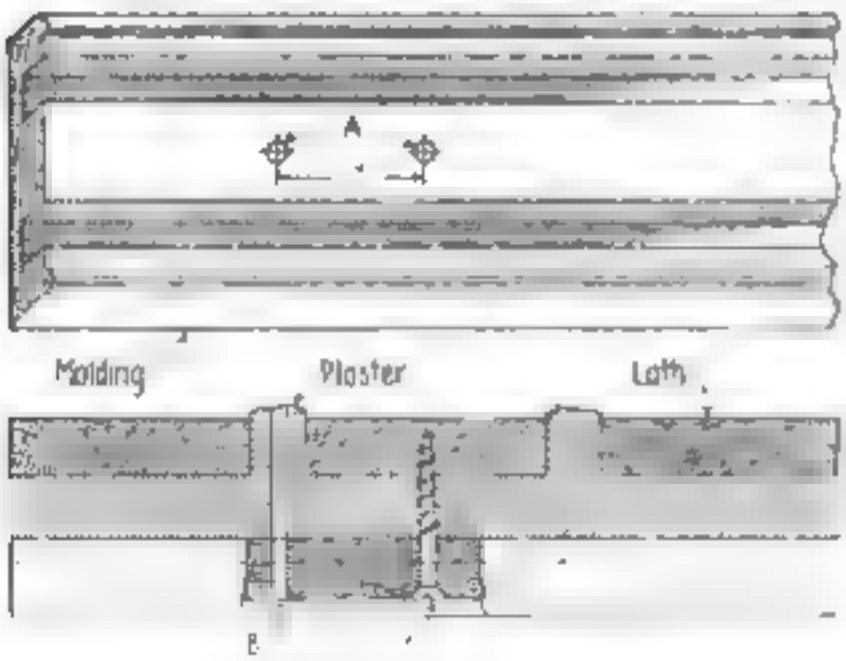
electricity it has on either plate, divided by the potential difference between the plates. A condenser would, therefore, have a capacity of unity in the practical system of units if it would hold a quantity of one coulomb, (the quantity of electricity transferred when a current of one ampere flows steadily for one second), at a difference of potential of one volt. Such a capacity is called a farad. This unit represents, however, an enormous capacity as compared to those met with in practice, so that it is usual to express capacities in microfarads, (m.f.). Thus, one m.f. = 0.000001 farad = farad $\div 10^6$ = farad $\times 10^{-6}$. But, whenever the general equation is used, the capacity must always be reduced to farads.



A number of plates made up into sets

Securing Wood or Metal Molding to Plaster Walls

THE electrician will find, when putting up wood or metal molding, that by drilling two holes, *A*, 1 in. apart, instead of one hole, every 3 ft., that not only will time be saved but the molding will be more secure. The reason for this is that if the hole *B* was used and the screw went through the plaster between the laths, it would be a simple matter to put a screw in hole *C* and to strike a lathe into which the screw could easily be fastened.



Two holes drilled close together into the molding hastens the work in putting it up

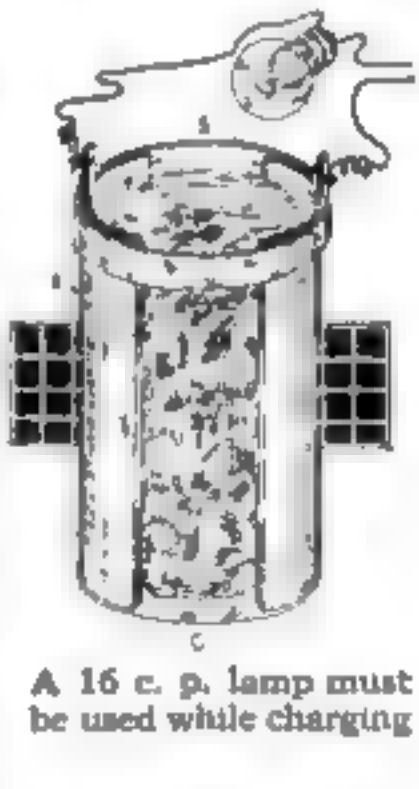
Now We Reach the Philippines Directly by Wireless

THE last link in a long chain of wireless stations, reaching from Arlington, near Washington, to the Philippine Islands, was recently forged. Cavite, this latest station, situated near Manila, has been building for some time. At its opening Admiral Knight, commander of the Asiatic fleet, sent a message of greeting to Secretary Daniels. In his reply the Secretary commented upon the ease with which our warships in Asiatic waters can now be reached. The chain of stations consists of Arlington, Darien, San Diego, Pearl Harbor, and Cavite.

A Small Storage Battery Made With a Sponge

A STORAGE battery can be made from two lead plates and an old sponge, that will give good service for lighting a small lamp or running small motors.

The battery is made with a one-pint glass fruit jar. *A*, two lead plates *B*, 1/8 in. in diameter and as long as the jar, are bent to set opposite each other, each covering one-fourth the inside circumference of jar. A large coarse sponge *C* is obtained which must be thoroughly cleaned and dried. Then obtain a piece of lead, and with a coarse file cut off enough filings to fill every pore in the sponge. When this is done, sprinkle the filings on the sponge which is in the jar between the plates. Be careful to keep the filings from falling out of the pores. The sponge must fit tightly against the walls of the jar to hold the filings in. Next fill the jar with one part sulphuric acid to seven parts of distilled water.



A 16 c. p. lamp must be used while charging

If this battery is charged in series with a 16 C. P. lamp on 110 volt D. C. line it will give 2 volts and 14 ampere hours.—WILLIAM HARRIER.

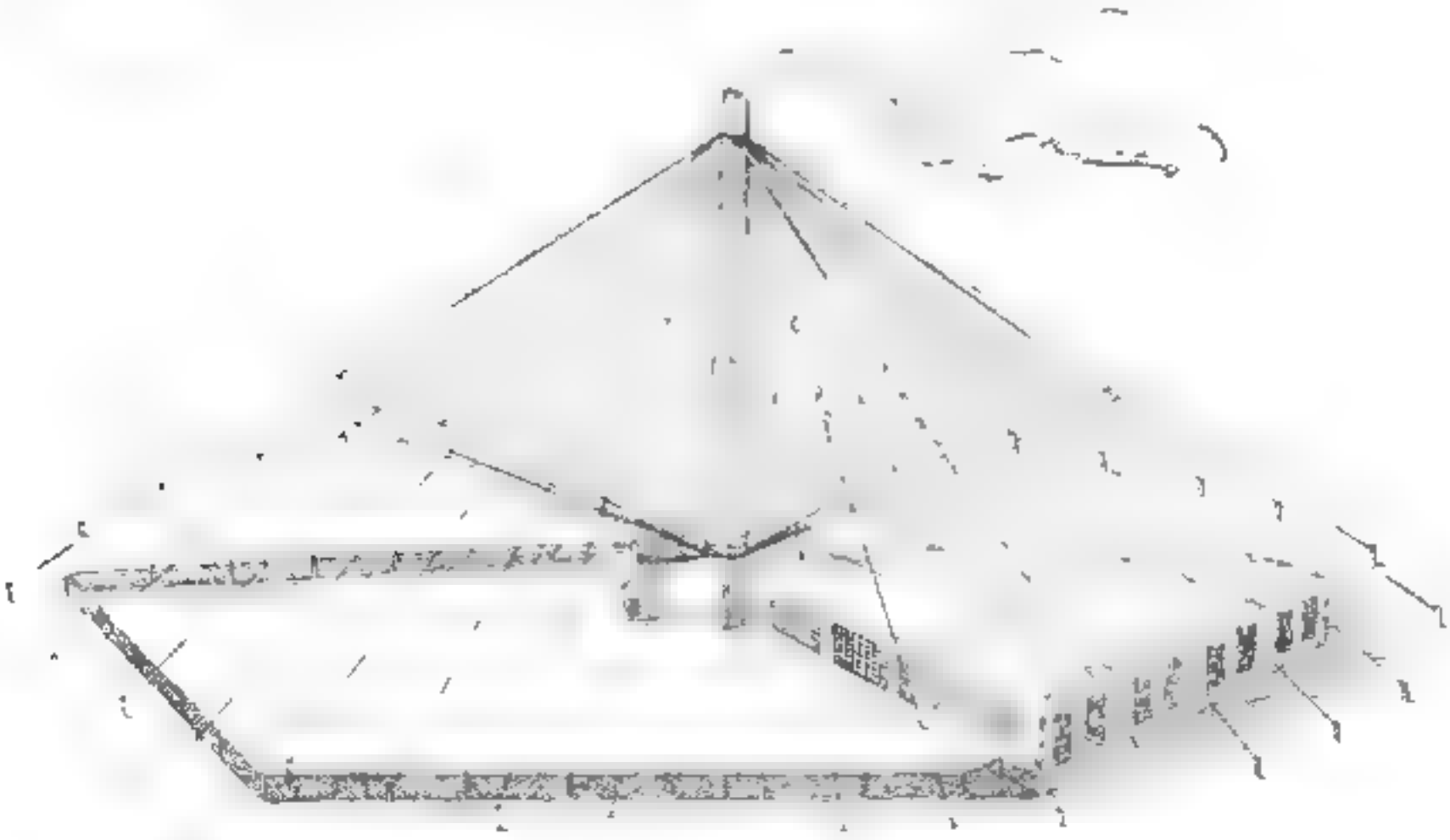
How the Zeppelin Raiders Are Guided by Radio Signals

An ingenious system not unlike that of the flashing light which guides mariners along the rocky coasts

A ZEPPELIN which is sent from Germany to England on a bomb-dropping expedition must travel by the shortest route. Only a limited amount of fuel is carried in order that the load of bombs may be as great as possible. But how does the captain of the ship determine that route? In time of war cities are darkened and all guiding lights are extinguished. The stars may help him. The trouble is that he travels so fast that he would have to read them at least ten times as often as would be necessary on board a ship at sea. Again, the sky may be overcast with no stars visible at all, although a war Zeppelin capable of flying four miles high could escape by rising above the clouds.

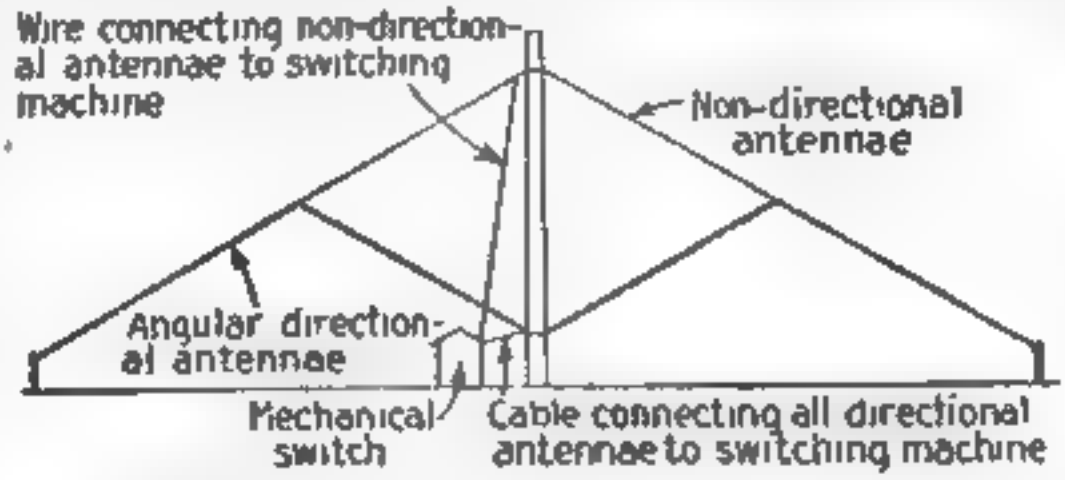
This is very plausible to the lay mind, but perhaps too far from the real facts. Actually the darkening of cities has never prevented finding the route. Rather invisibility of the ground due to "thick" air or actual fog, has. Even then a fairly true course might be steered by "dead reckoning"; i. e., by computing distance and direction from log and compass, and then tracing the results on the map. But the unknown and variable wind-drift prevents this. Measuring the earth's magnetism would prevent getting far astray, but the needed apparatus would be heavy, measurements must be very numerous, and each measurement means extremely difficult and accurate work.

Radio communication was soon found to offer by far the most convenient solution of the problem. The L-49, which recently fell into the hands of the French absolutely intact, had a marvelously complete radio equipment. Even before the war, a passenger Zeppelin, the *Viktoria-Luise*, kept in continuous communication with the Island of Nordeney in the North Sea while scouting near Strassburg on the upper Rhine. That was in 1912. Since then the range of a Zeppelin's radio apparatus has been trebled.



A Telefunken-compass sending station. Factory chimneys frequently serve as aerial supports, as in this case. Germany thus effects a saving of metals valuable for other war needs

On page 451 and following of the March 1916 number, POPULAR SCIENCE took up and discussed at considerable length two radio directional systems, the Bellini-Tosi and the Telefunken, by which ships at sea could find their way along coasts and into harbors in spite of fog or blinding storms. It is this apparatus which has evidently been adapted extensively to war Zeppelins.



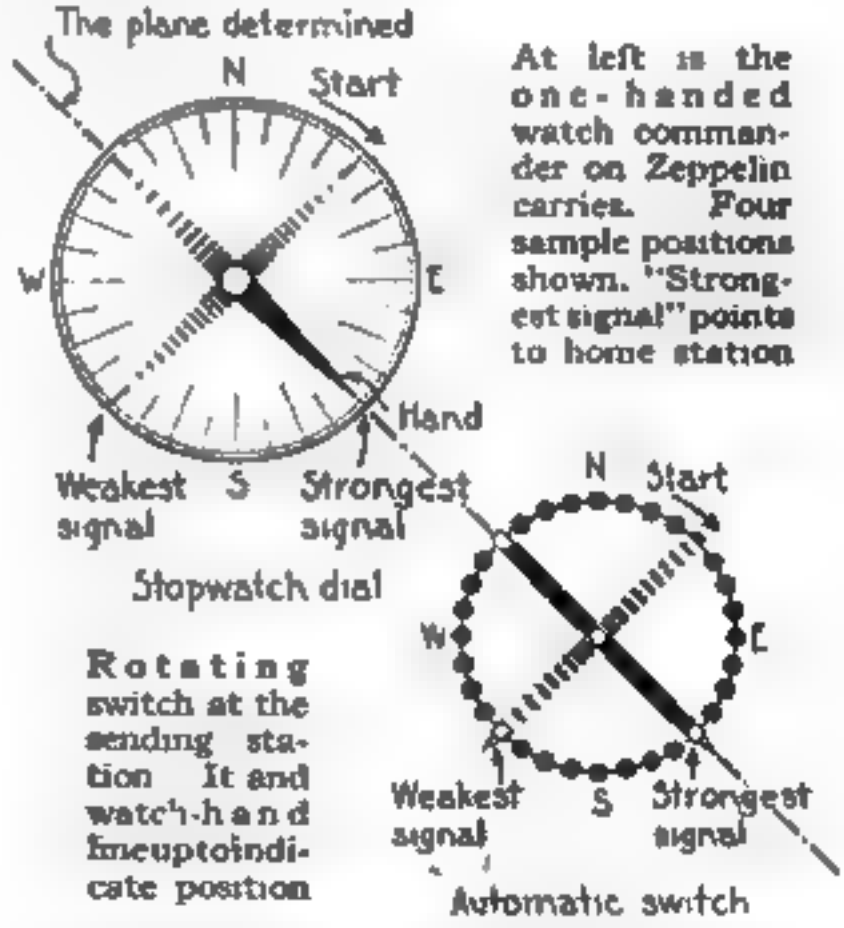
Section of Telefunken-compass sending station. Sixteen such sets form the aerial shown on page 632

In wireless, parallel antennae give the strongest signals; those at right angles, the weakest. It is this principle which makes all radio direction-finding possible.

In the Bellini-Tosi system the moving station sends signals to a fixed station, and the fixed station, by special apparatus, determines the direction of the sender and thereupon transmits the information to the sender by radio. Under the Telefunken plan, the moving station determines its own position, powerful signals having been sent out from fixed stations along shore. This seems to be the better arrangement, as it is more practicable to have powerful stations on shore than aboard an airship. The signals can radiate out over longer distances, the sending station can be entirely automatic, and on board the airship the commander need only listen for loudest signals (or weakest, whichever he prefers), hold a one-handed stop-watch—hereafter described—in his hand, and he gets his direction almost at once. No doubt the many war Zeppelins which have ventured out over England have used this system. Details of the whole plan are interesting.

The powerful sending stations in Germany have thirty-two very long, slanting antennae radiating from a tall central mast. These antennae are the exact equivalents of the rays to be found on every ship's compass, and, like them, represent the thirty-two fixed points of the compass. A mechanically operated switch connects with opposite pairs of these separate aerials once every thirty seconds. A single telegraphic dot is flashed out at each connection. In this way all points of the compass are reached every half-minute.

Any German aircraft, whether it is a Zeppelin or a small reconnaissance biplane, is able to pick up these dots, and by this means it can determine its direction relative to the sending station. No other addition to its regular receiving apparatus is required. However a calibrated pocket stop watch must be referred to. By "calibrated" we mean that the hand of the watch runs like the previously described switch, and that it makes a complete revolution around the dial in thirty seconds. The dial is, of course, marked like that of a navigator's compass with the usual thirty-two points instead of with ordinary minutes and seconds.



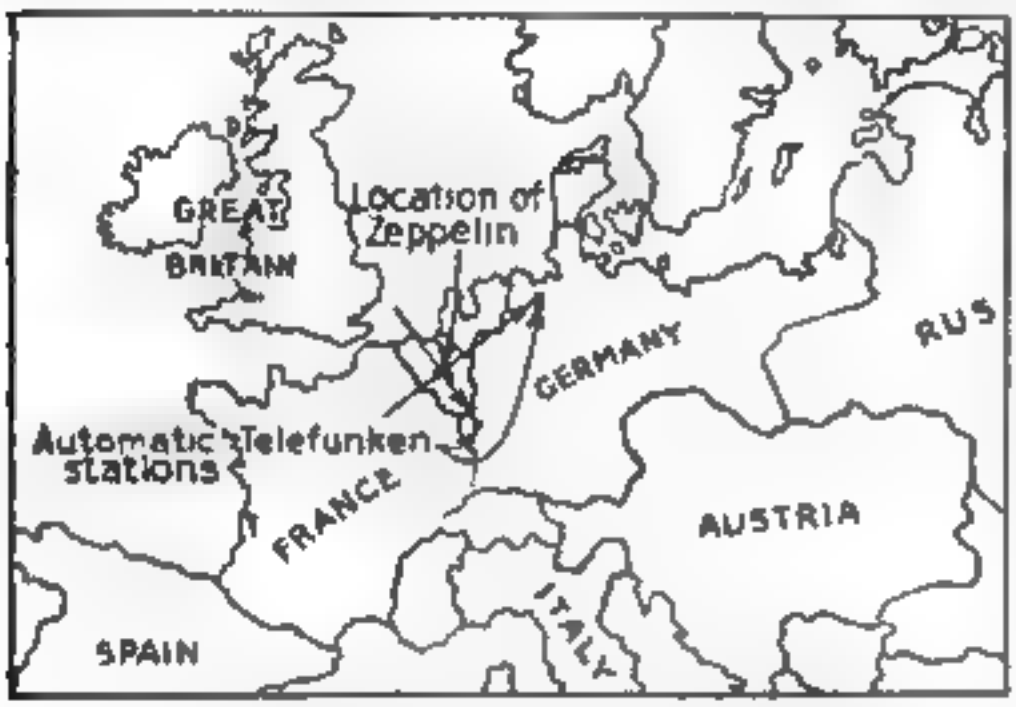
At left is the one-handed watch commander on Zeppelin carries. Four sample positions shown. "Strongest signal" points to home station

Rotating switch at the sending station. It and watch-hand fmeuptoindicate position

Since commander's watch-hand and the sending switch rotate in unison, loudest signal determines plane in which sender is located

Apparently the Zeppelins using the Telefunken-compass are equipped with ordinary non-directional aerials for receiving the signals.

In actual operation the sending station mechanically rotates its switch and sends its dots as continuously as a lighthouse with a rotating lantern flashes out beams of light. But there is a short stop before each new rotation, which commences with the first dot flashed by the north-pointing antenna. During this short stop another but different signal is sent—a non-directional signal which is flashed over all the antennae and which is heard clearly and loudly in any direction. This signal identifies a station by giving its name or its number and supplies the information that in another moment another cycle of dots will be sent out toward east, south, and west, commencing at the north. The aircraft commander thereupon sets the hand of his stop watch to the north. He may press the starting button as soon as he hears the first dot, and the stopping button as soon as he hears the weakest dot, or he may press the button at the strongest dot. In actual practice, he pushes the button at the dot immediately following the weakest (or strongest) signal. The difference in loudness is considerable from dot to dot. Indeed, the loudness progresses or decreases around the circle of the compass, depending upon the direction in which one reads.



Intersecting lines from sending stations tell a Zeppelin commander his position accurately

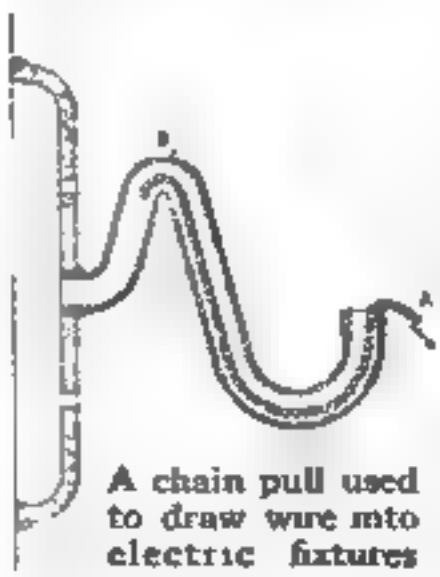
Imagine what a sensation it must be to be up in a Zeppelin high over an impenetrable cloud bank, the sky overhead obscured by the bulk of the gas bag, and for these reasons all the landmarks by which a man ordinarily locates himself obscured. Yet from somewhere beyond the clouds beneath comes that clear radio call indicating that in this direction at least lies a home station. The beacon is welcome. All the Zeppelin commander needs to do now is to tune a bit differently and go through the same performance with another automatic station. In a minute or two he has read on his stop watch dial his direction relative to two different stations whose identity he knows. Drawing lines in these two directions from the locations of these stations on his map, he sees his own location plainly marked on the same map at the point where both lines intersect. More he could hardly demand. But he may repeat the procedure many times in order to check up his location as frequently as the rapid progress of his craft demands.

In peace time the range was intentionally cut down to fifty miles in order to prevent interference with regular wireless traffic. But in war, especially during a raid, a vastly greater amount of current may pass through the switches and the antennae may be worked to full capacity.

Although the Zeppelin's long range Telefunken compass uses the same theoretical principles as the Bellini-Tosi method; that is, that parallel aerials result in loudest signals, the Bellini-Tosi method is apparently ill-adapted to Zeppelins. The Telefunken plan seems probably the one universally used.

Fishing Electric Wires Through Tubes in Fixtures

WHEN fishing wires through a fixture, which has a sharp angle, a piece of chain *A* from a pull chain socket can be used to good advantage. If a wire is used it may get caught at point *B*, while the flexible chain readily passes around this bend. A strong cord can then be attached to the wire which is easily drawn through the fixture.



A chain pull used to draw wire into electric fixtures

Wireless Work in Wartime

IX.—The Primary Oscillation Circuits of the Spark-gap Transmitter

By John V. L. Hogan

THE March article of this series discussed the power-supply circuits of the spark-type radio transmitter, showing how alternating current energy was supplied to the power transformer and converted to a *higher* voltage suitable for charging the primary condenser. The illustration Fig. 34 is reproduced this month so that the details of this assembly

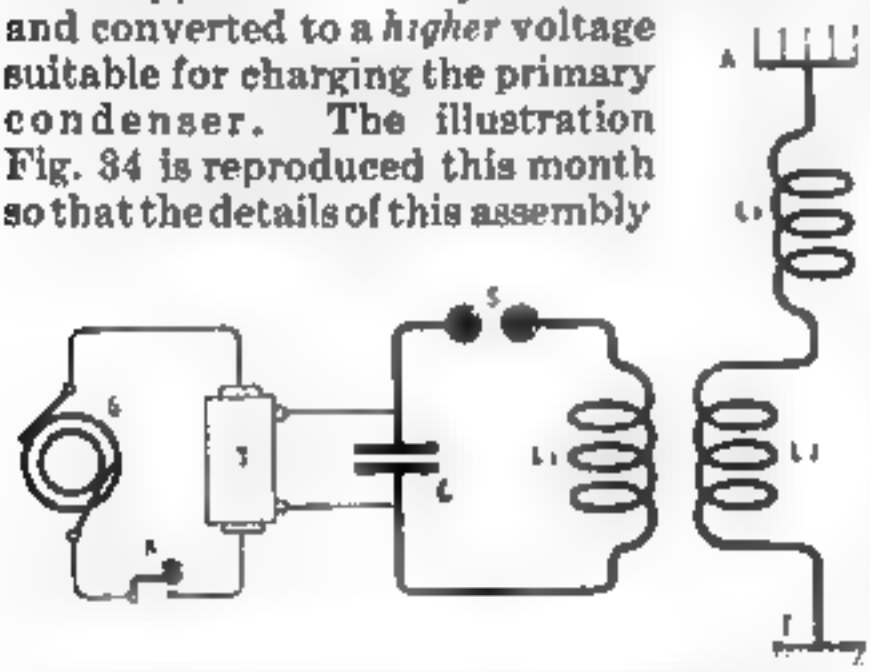


Fig. 32: The coupled two-circuit transmitter overcomes difficulties from the plain antenna

of apparatus may be held clearly in mind, and Fig. 32 is also shown again since it gives the normal connections from the primary condenser *C* to the spark-gap *S* and the several tuning coils. This instalment will take up the behavior of the spark-gap and the primary oscillation circuit, which is composed of the gap *G*, the condenser *C* and the primary L_1 of the oscillation transformer or inductive coupler.

In the first place, it must be understood that the transmitter really has two primary circuits and two secondary circuits, just as it has two transformers. With reference to the low or audio frequency power-supply, (which is usually of from 60 to 500 cycles per second frequency), the primary circuit comprises the generator armature, the key and the primary of the power transformer. The audio frequency secondary circuit involves the power transformer secondary *S*, and the condenser, *C*. In regard to the radio frequency oscillations which are produced by the condenser (and which in turn produce the wireless waves), the other primary circuit consists of the condenser *C*, the spark-gap *G*, and the primary coil L_1 of the oscillation transformer or inductive coupler. The radio frequency secondary is formed of the antenna *A*, the antenna loading coil L_3, the secondary L_2, of the inductive coupler, and the ground connection *E*.

The Voltage Applied to the Condenser

Considering Fig. 34 for a moment, it should be evident that if an alternating current of 500 cycles (complete reversals) per second is developed by the generator, corresponding voltages will be applied to the plates of the condenser *C*. At intervals of 1/1000 second this condenser will be charged in alternate directions, first with the upper plate positive and the lower negative, then with the upper plate negative and the lower positive. If the wires *X* and *Y* are left open or disconnected, the condenser charges will merely flow back through the secondary winding *S* as the potential changes at each half cycle. The illustration Fig. 35 should make this action even more clear, since it shows the potential of the upper plate of the con-

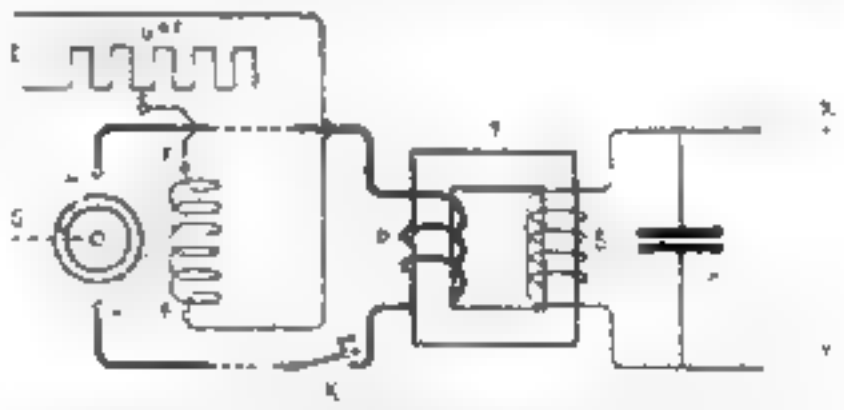


Fig. 34: In addition to the generator itself the circuits of the transmitter are shown

denser (with respect to the lower plate) at the various instants in a full cycle of 1 500 second. The wavy line represents the passage of time by its progress toward the right (thousandths of one second are marked off along the horizontal line or axis of time) and the potential of the condenser by its vertical height

at any point corresponding to any particular instant. The vertical or voltage axis on the left is marked off to show positive voltages above the central or zero point, and negative voltages below. If we follow along the curve we find that at the beginning, at 1/1000 of a second, at

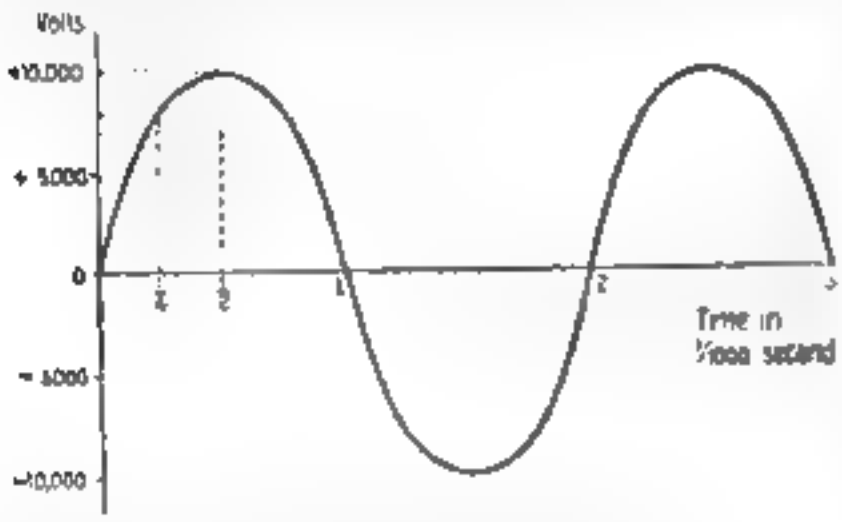


Fig. 35: Graphical representage of the five hundred cycle secondary voltage

2,1000 second, at 3/1000 second (and consequently at each one-thousandth second or at the end of each half cycle) the voltage of the condenser is zero. This is shown by the fact that the wavy line crosses the zero line at the point corresponding to each of these instants, and means that for the moment the condenser has no charge. If we look for the points of maximum voltage, we find that at half a thousandth of one second the condenser is charged to 10,000 volts positive, at one and one-half thousandths to 10,000 volts negative, at two and one-half thousandths to 10,000 volts positive again and so on continuously. In the same way we find that, starting from zero time and zero voltage (at the extreme left of the diagram) the voltage gradually rises in the positive direction, reaching about 7000 volts in one quarter of a thousandth of one second, passing through the high point just mentioned, and then falls to zero and begins a similar operation in the reversed direction.

The Charge in the Condenser

The condition just examined is based upon the assumption that nothing is connected to the wires *X* and *Y*. When the condenser is charged either positively or negatively, a certain definite amount of electrical energy is stored in it for the time being. This energy may be allowed to flow back into the secondary coil *S*, as has just been shown, or it may be withdrawn from the condenser for some more useful purpose. The amount of electrical energy thus stored may have large values for a time; the quantity depends entirely upon the capacity of the condenser (its storing ability) and the voltage to which it is charged. Obviously, to take the energy out usefully one must have some method of catching the condenser when it is charged; to get the most energy from each half cycle, the charge must be withdrawn at the instant of maximum voltage. This requires some automatic device which works regularly and quickly, since the highest voltage occurs only each one-thousandth of a second and lasts for only a few ten-thousandths of one second.

How the Condenser Discharges Through the Spark-Gap

Let us suppose that the condenser is shunted by the circuit of Fig. 32, which shows the spark-gap *S* connected across it through the primary L_1. If the spark-gap consists of two electrodes which are separated widely, there will be no new effect; if, on the other hand, the spark-gap points are brought within about ⅓ in. of each other, the potential of 10,000 volts will be sufficient to break across the air space. This will cause an entirely new and useful sequence of events, as may be seen from the following: If the gap electrodes are separated to exactly the distance which permits a spark to pass when a voltage of 9,500 is applied across them, it is evident that it will not be possible to charge the condenser to 10,000 volts pressure. This is because when the voltage has risen to the breakdown point of 9,500 volts, the energy in the condenser will discharge across the gap in the form of an electric spark. The illustration Fig. 36 will serve to give a rough idea of how the condenser potential is affected; following the voltage line from zero at the left, it is seen that when the potential of 9,500 is reached there is a sudden drop through zero voltage and on farther down to about 8,000 volts negative. This happens because all the stored electrical energy rushes across the spark-gap *S* through the inductance (primary coil) L_1 shown in Fig. 32. The discharge does not stop at zero voltage, but continues farther in the same direction because of the magnetic effect of the primary coil

L_1; when it has built up to a fairly high voltage negatively, the current in the coil and gap circuit reverses and an inverse discharge begins in the opposite direction. This also continues beyond the zero voltage point, and results in a positive charge of the condenser. Here the condenser begins a third discharge, this time in the same direction as at first. Thus a rapidly reversing current is set up in the condenser, coil and spark-gap circuit, the successive swings of current from one side to the other becoming smaller and smaller until the energy is all used up or withdrawn, or until the spark-gap regains its normal non-conducting condition and prevents further passage of a spark.

Detailed Study of Condenser Voltage

If we examine Fig. 36 a little more closely we may see just what happens throughout a full cycle of applied alternating current (audio frequency) power. Beginning at zero, the condenser voltage builds up to about 9,500 in a little less than one-half a thousandth of one second and then, at the point *A* on the curve, the high electrical pressure makes the spark-gap conductive and the oscillatory discharge begins. This discharge consists of a number of rapid or radio frequency alternations of potential (with corresponding radio frequency alternating currents), and lasts for about one-quarter of a thousandth of one second before the energy is used up and the spark-gap again becomes non-conductive. This occurs at the point *B* of the curve. With the spark-gap open (no spark passing) the condenser begins to assume its normal voltage from the audio frequency alternating power applied to it, and rises to, say, 5,000 volts at the point *C*. This pressure is not enough to break down the spark-gap, and consequently the condenser potential follows the impressed potential of the power transformer secondary, passing through zero at *D* (the end of the first half cycle of power) and then beginning to charge negatively or in the reversed direction. At *E* the condenser potential has reached 9,500 volts negative (i.e., with the lower plate positively charged) and the spark-gap again becomes conductive and allows the discharge to pass through the primary oscillation circuit composed of the condenser, the primary coil L_1 and the spark-gap. As before, radio frequency oscillations continue for about quarter of a thousandth of a second (to the point on the curve marked *G*) and then the gap becomes

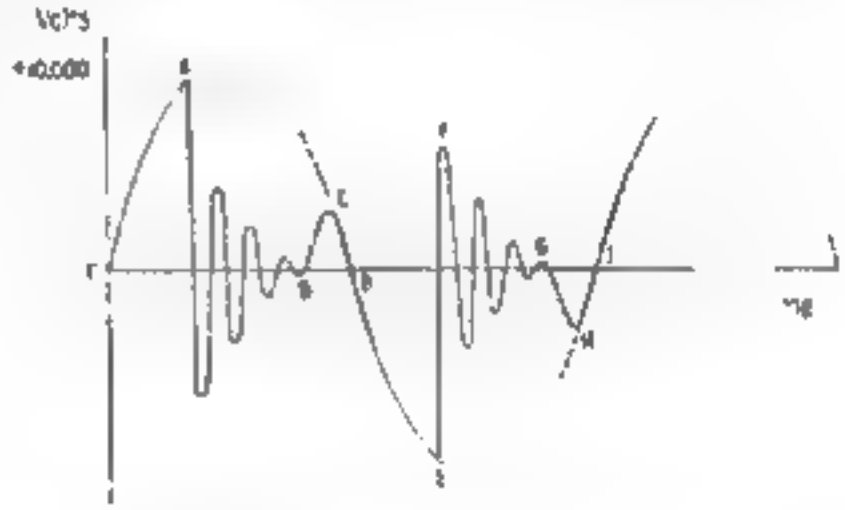


Fig. 36: How the radio frequency oscillations are produced by secondary discharge

non-conductive. The normal charging of the condenser follows through the high point *H* and the zero point *I*, at the end of the second half cycle or the first complete cycle of applied power. Thereafter the same series of operations is repeated, and sparks representing a group of dwindling radio frequency oscillations pass in the middle of each half cycle. Thus, if the applied power has a frequency of 500 cycles per second there will normally be produced 1,000 sparks or groups of oscillations per second.

Mechanical System for the Conversion of Frequency

We have evidently been considering an arrangement of apparatus which will convert, by way of the condenser discharge, audio frequency alternating current power into the radio frequency oscillations which are necessary for wireless signaling. The action may perhaps be more vividly appreciated if we consider a similar mechanical system for increasing frequency. Let us imagine a stiff spiral spring *S* having a weight *W* hanging upon it, and supported from a heavy beam *B* as shown in Fig. 37. If a thin thread *I* is tied to a hook set in the bottom of the weight, we may slowly pull down on the spring and weight system until the tension on the spring is great enough to break the thread. Then the weight will bob upward rapidly, and its inertia will carry it

somewhat beyond the point of rest and compress the spring. Thereafter the weight will immediately start downward; and it will continue to oscillate up and down in shorter and shorter strokes until the energy stored in the weight and spring system has been used up. This corresponds in many ways to the circuit

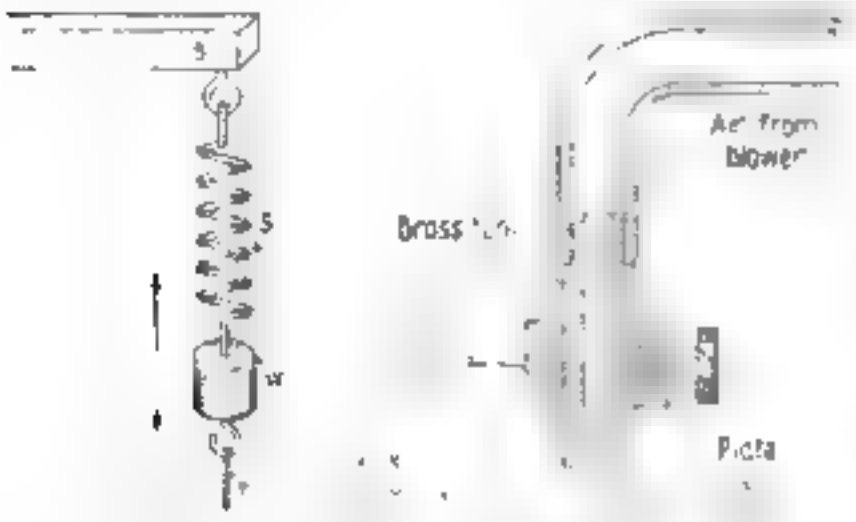


Fig. 37: Mechanical oscillating system
Fig. 38: Practical air-blast spark-gap

shown: pulling against the spring until the thread breaks is comparable to charging the condenser until the spark-gap breaks down, and the rapid up-and-down oscillations of the weight and spring are much like the rapid electrical oscillations in the condenser and coil circuit. The spring is analogous to the condenser C and the weight to the inductance coil L_1; it is the stress of the spring (and in the condenser) which trips off or breaks down the restraining element (thread or spark-gap), and it is the energy stored in the weight (and in the inductance coil) which carries the oscillations beyond dead center on each swing and so keeps the system vibrating.

Controlling the Oscillation Frequency

The two systems are alike as to another important point, viz., the frequency of the oscillations. We know from experience that the greater the mass of the suspended weight and the greater the flimsiness of the spring, the more slowly the mechanical vibrations of the system. By varying either or both of these we can make the weight bob up and down at almost any frequency we choose. In the same way, the frequency of electrical oscillations in the condenser and coil circuit is almost entirely dependent upon the size of the condenser and coil. The larger the condenser (the greater its capacity) and the larger the coil (the greater its inductance), the slower the radio frequency oscillations will be. Thus, by altering the electrical constants of the circuit (e.g., the capacity and inductance), we can make the oscillation frequency almost anything we desire. This matter will be treated in greater detail later.

The next point which should be considered here is the construction of a spark-gap which will work regularly and continuously. Commercial radio practice has brought out a great many types of spark-gap, but years of experience have shown that certain properties must be secured if satisfactory operation is to be expected. In the first place, the gap must always break down at some definite voltage. It is evident from Fig. 36 that if the potential which established conductivity across the gap varied, the oscillations would begin at different points in each half-cycle and that the oscillation groups would not occur regularly. If the break-down potential were normally 9,500 but sometimes became 8,000, when the lower value held the oscillations would start off too soon in the half-cycle, and the full discharge of the condenser would not be utilized. If it ran up to 11,000 volts, no spark would pass at all, and the charge for that particular half-cycle would be practically wasted in so far as the production of a group of radio frequency oscillations was concerned. Uniformity of sparking potential depends upon keeping the gap cool more than on anything else, since the hotter the gap the lower the potential at which it breaks down. For small powers the necessary cooling may be secured by making the spark-gap terminals large, since then the heat will be carried away rapidly by the mass of metal. For larger powers some form of artificial cooling is used.

A Successful Cooled Spark-Gap

A form of air-cooled gap which has been found satisfactory for many purposes, is shown in Fig. 38, and which is largely used by the French. It consists merely of a brass or copper tube forming one electrode and placed endwise to a flat plate which acts as the other terminal. A blast of air is fed through the tube by way of a rubber hose, and spreads out

over the surface of the plate. The spark passes between the rounded end of the brass tube and the flat surface, and hot conducting gases formed by the discharge are blown away by the current of air. By using large masses of metal and a strong blower, fairly heavy oscillating currents may be passed across the gap without overheating—especially if a low group frequency is used so that the gap may cool off somewhat between successive sparks. A gap of this sort was used in the Eiffel Tower station which sent signals across the Atlantic to Arlington, Virginia, in the international longitude experiments of some years ago. It is even more successful with smaller powers, and represents, perhaps, the best practice in the so-called stationary open spark-gaps.

In the next article, the construction and action of the rotary and modern "quenched" gaps will be described, and thereafter the interactions of the two oscillating circuits and the production of radio waves will be discussed.

(To be continued)

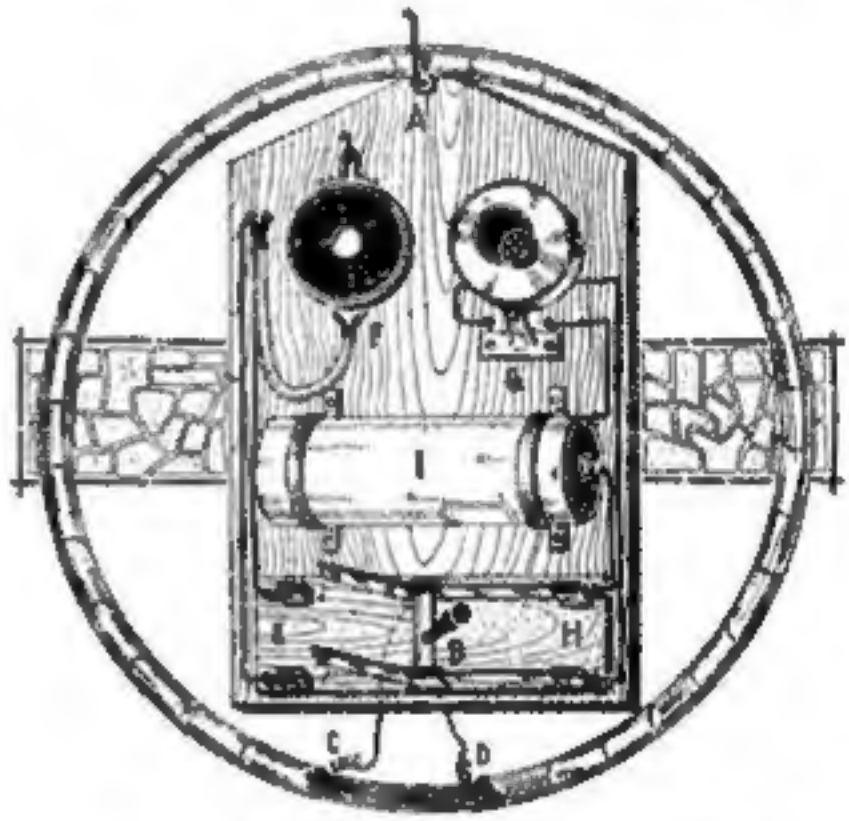
A Simple Compact Short Distance Wireless Telephone

VARIOUS methods have been devised by which one can talk without wires to a person over four thousand miles, but it is not generally known that in 1882 Prof. Alexander Graham Bell constructed an apparatus with which he was able to transmit the voice several miles without metallic conductors. The principle involved was that of magnetic induction, which, simply explained, is a field of force induced by passing an electric current through a coil of wire. This so-called "field of force" is again detected by a similar coil placed in a direct line with the source. The limited distance that the voice could be transmitted, due to mechanical difficulties, prohibited such an apparatus from being of commercial value, but for experimental purposes, or for communicating short distances, such as between rooms or nearby buildings, it is practical and it is something unusual for the amateur to build.

The accompanying drawings illustrate a compact outfit suitable for talking to some one 50 to 100 ft. away.

A base-board *A*, somewhat like the one shown, should be screwed to the wall at a convenient height for talking. A common coat-hook is fastened to the peak.

Then make a large coil of insulated bell-wire (about 3 or 4 ft. in diameter) using about 350 ft. of wire. Number 20 gage is a good size for all practical purposes, but the finer the wire and the



One of the two apparatus used for sending messages by home-made wireless telephone

greater number of turns with a corresponding increase in the diameter of the coil, the greater is the distance one can talk. Leave 1 ft. or more of the ends of wire projecting and wrap the entire coil securely with tire-tape. The coil is then ready to hang over the hook on *A* and should be large enough to hang clear of the bottom edge of *A*.

A two-way knife switch *B* of the style shown, is attached to the base of *A* and the center terminals are connected to the ends of the coil *C* and *D*. One side of the switch *E* is then connected to a pony telephone receiver *F*, which can be hung from a convenient hook near a telephone transmitter *G*. This transmitter is connected to the opposite poles of the switch *H* as shown; a dry-cell *I* cutting in one line. The battery is fastened to *A* by means of a pair of metal straps.

A duplicate apparatus should be placed at the other end of the "line," in a position as nearly parallel as possible, to receive the full benefit of the "field of

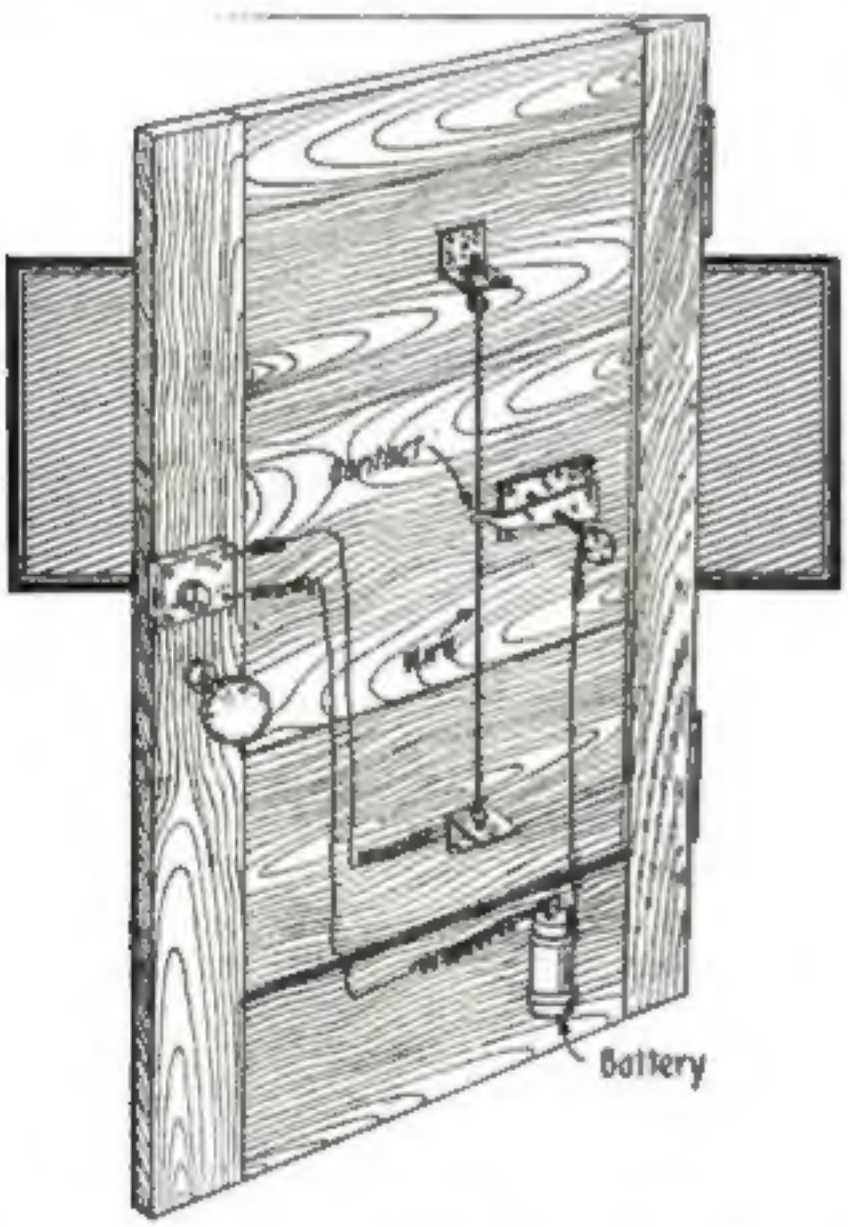
force." When one desires to talk vertically; that is, from one floor of a house to another; lay the coils flat on a table and in line with each other.

To converse; throw the switch to *H* and call the other party by tapping on the transmitter diaphragm. Immediately upon speaking, throw the switch to *E* to receive the reply. The other party duplicates these motions. When through speaking, leave the switch at *E*.

Larger coils may require an additional cell to assist in lengthening the speaking distance.

A Keyless Electric Lock for Use on a Panel Door

I HAVE attached a secret lock to the door of my room which does not require any key to open it. The lock itself



This obedient electric lock opens the door when you knock in the right place

is an ordinary electric lock, but it is the way that the contact is made through it in opening the door that makes my scheme different from others. A vertical wire is suspended the full length of the panel on the inside of the door. Directly opposite the middle of the wire and quite close to it, a small brass plate is mounted. One end of the battery-and-lock circuit is connected with the vertical wire and the other end with the brass plate. Whenever I desire to enter my room, I simply knock on the outside of the panel; the wire vibrates, it finally touches the plate, the circuit is closed, and the lock opens.—THOMAS W. BENSON.

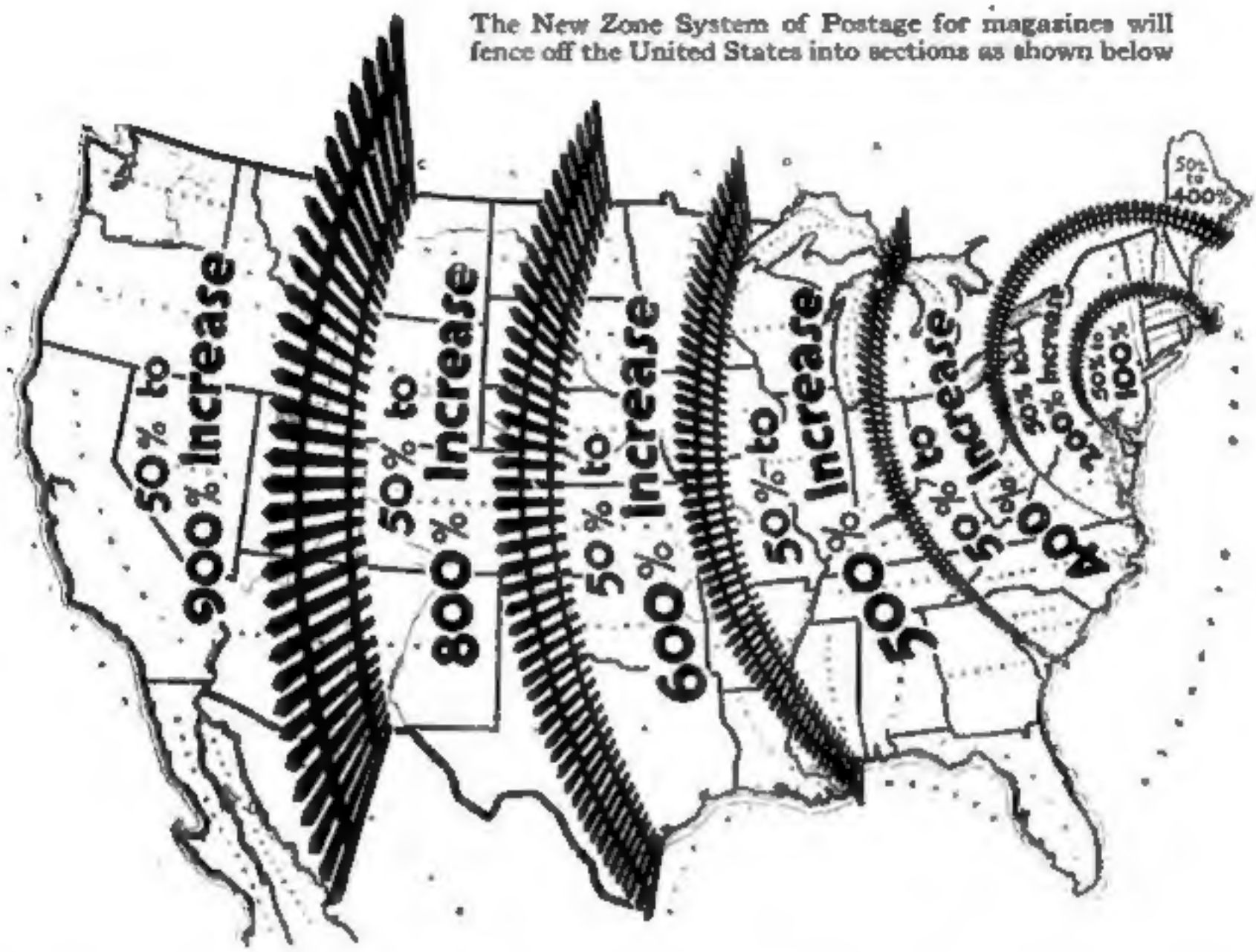
A Simple Method of Silvering Brass and Copper Articles

IF you desire to coat the surface of brass or copper articles, the following method is very simple and the results are exceedingly satisfactory.

Procure some scrap silver from a local jeweler and dissolve it in strong nitric acid, diluted with about half its bulk of water. Be sure always to pour the acid slowly into the water and not vice-versa, or it will fly up into your face. Stir the mixture with a glass rod while mixing it. When mixed pour it into a glass bottle or a porcelain saucer. If the acid is slow in attacking the silver, warm it gradually. Dense fumes are given off, so this work should be done on a grate fire where the fumes can pass up the chimney, or on an oil stove outdoors. Use a great deal of care in handling the acid and do not inhale the fumes from the chemical action.

When the silver is dissolved, dilute the solution with a quart of water and pour a strong solution of common salt and water gradually into the nitrate of silver solution. A dense precipitate of chloride of silver results. Collect the chloride of silver on filter paper by filtering it, wash it several times and dry it. Then mix the substance with three times its own bulk of table salt and twice its own bulk of cream of tartar; taking care to mix the ingredients thoroughly. It is then ready for use. This is rubbed on the brass or copper article with a wet cotton rag. After the silvering is complete, wash the article with hot water, and varnish it to prevent tarnishing. The unused silvering solution should be put into a bottle and the bottle set in a cardboard box and kept in a dark place to prevent it turning black.

Do You Want to Split Up the United States?



NO, of course you don't. But you are helping to do it right now by not writing a letter of protest to your Congressman and your Senators about the Zone System for magazine postage recently passed by Congress.

How quickly would the States be broken up into separate countries if we had to pay import taxes on all goods shipped between states? Well, it wouldn't take very long.

But Congress has passed a law by which it will cost more to get your magazines delivered the farther you live from where they are published. The farther west you live the more you will pay for magazines published in New York, Philadelphia or Boston.

Canada, at war for three and a half years, still sends two pounds of reading matter for one cent to the farthest points of the Dominion. Our Government proposes to charge ten cents a pound for carrying to the Western States the advertising portion of POPULAR SCIENCE MONTHLY and other publications—*just twenty times Canada's rate!* We should be able to deliver as cheaply as Canada can.

When the new Zone System is finally in full force, the cost of magazines in the Middle and Far West will be so great that thousands of people will be obliged to give up their magazines and other periodicals. They no longer will keep up with the intellectual life of the country. The West will no longer be united in the old compact way with the East.

The new Zone Law has not yet been put into effect. You can help to get it repealed. Write your Congressman and your Senators and protest. If you do not know their names, ask POPULAR SCIENCE MONTHLY or your Postmaster, but whatever you do *protest*

Soaring High with Borrowed Wings

This is not a nightmare but the presentation of a daring flight—imaginary, it is true, but completely within the limits of possibility. An earth-born Ford, is carried aloft by the wings of a powerful modern warplane, conveying men, arms and ammunition to the point where they are needed. The plane then returns for another Fordful of men